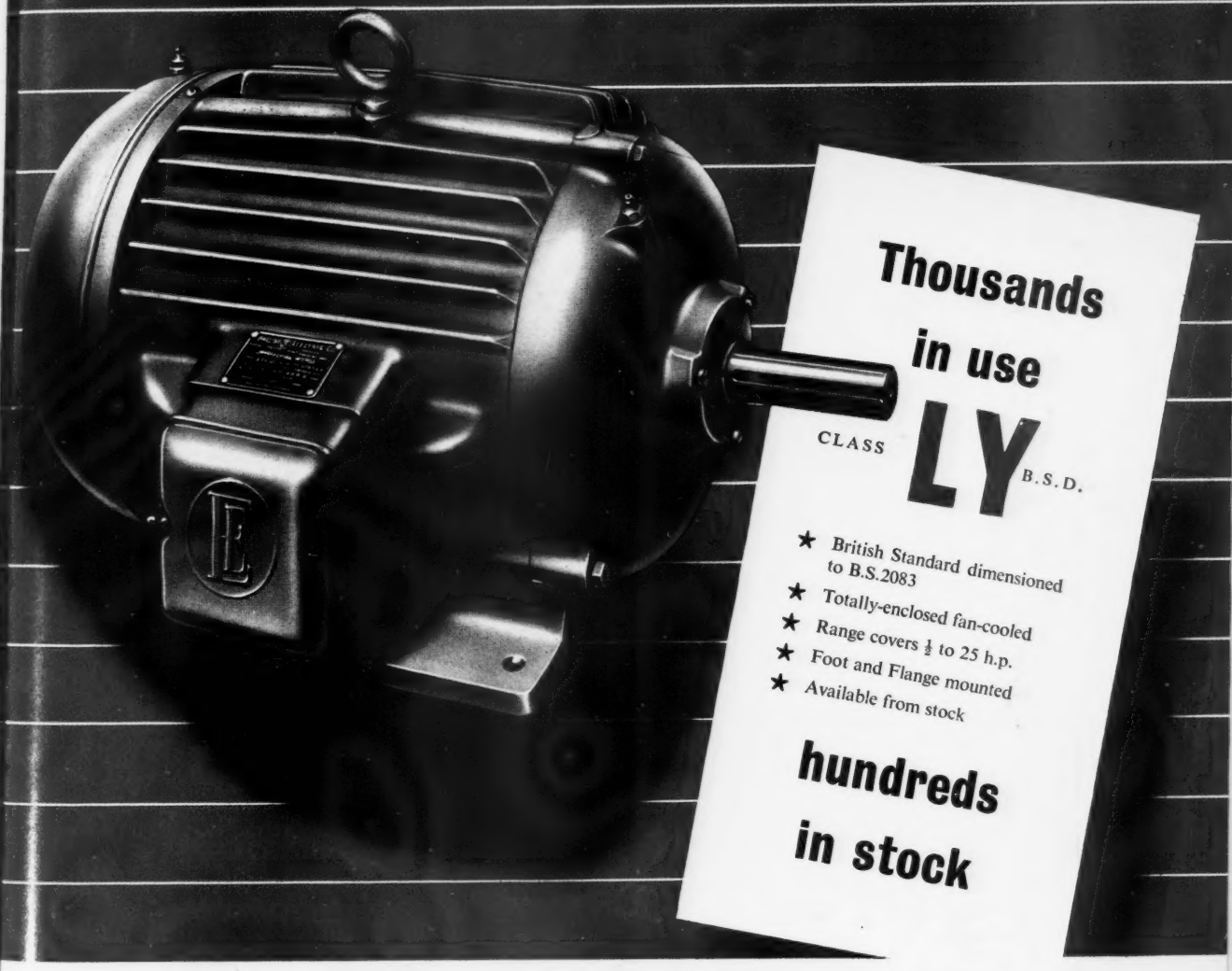
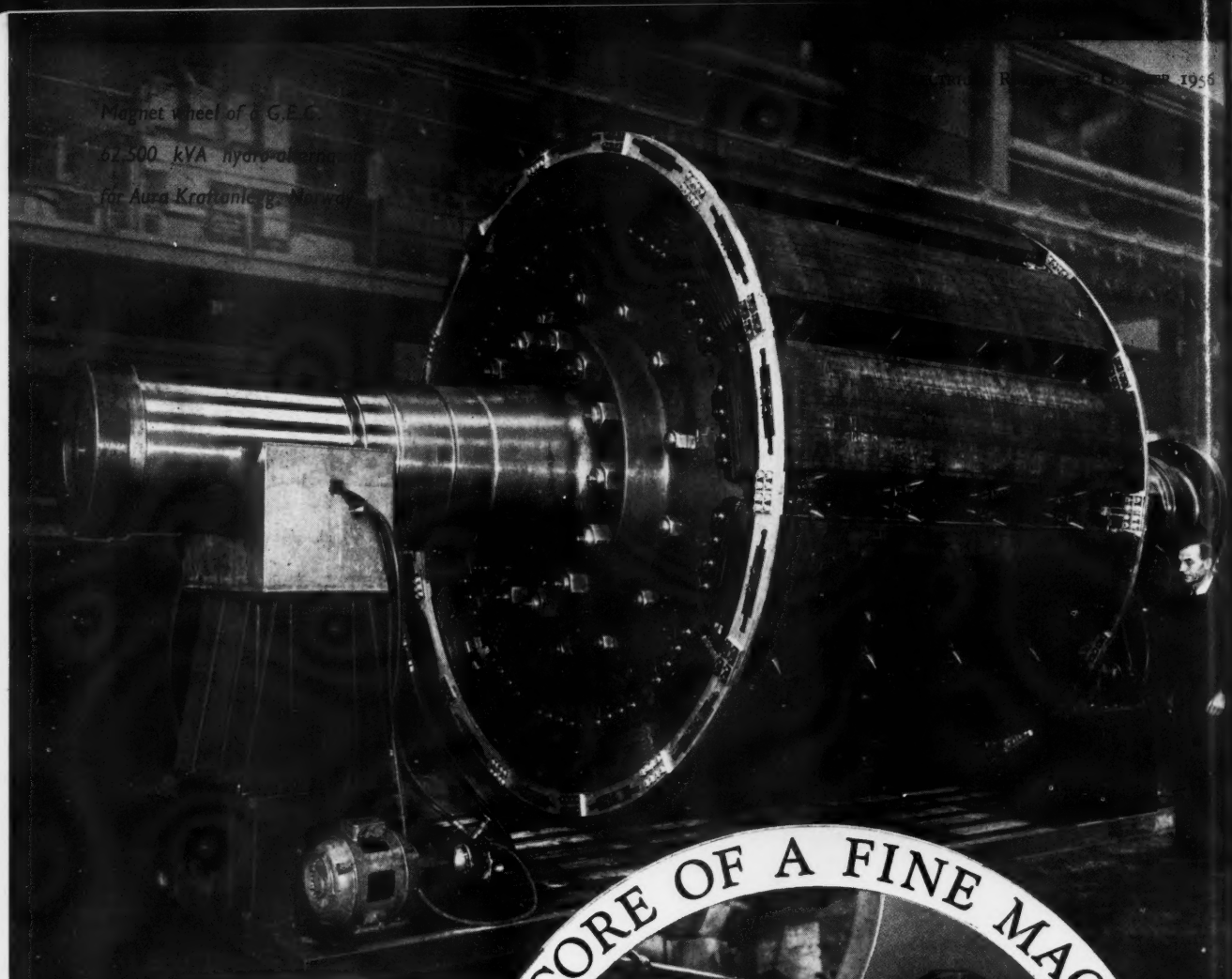
ELECTRICAL REVIEW


Thousands in use
CLASS LY B.S.D.
★ British Standard dimensioned to B.S.2083
★ Totally-enclosed fan-cooled
★ Range covers ½ to 25 h.p.
★ Foot and Flange mounted
★ Available from stock
hundreds in stock

'ENGLISH ELECTRIC'
industrial motors
THE ENGLISH ELECTRIC COMPANY LIMITED, QUEENS HOUSE, KINGSWAY, LONDON, W.C.2
Industrial Motor Works, Bradford
RUGBY · BRADFORD · LIVERPOOL · ACCRINGTON



THE CORE OF A FINE MACHINE

LAMINATIONS BY

LAMINATIONS of all types, in all sizes and in all grades of material.

FERROSIL cold-reduced electrical sheet and strip.

ALPHASIL cold-reduced oriented electrical sheet and strip

RICHARD THOMAS & BALDWINS LTD.

LAMINATION WORKS: Cookley Works, Brierley Hill, Staffs.
MIDLAND SECTION OFFICE: Wilden, Stourport-on-Severn, Worcs.
HEAD OFFICE: 47 Park Street, London, W.1

Our Cookley Works is one of the largest in Europe specializing in the manufacture of laminations for the electrical industry.

RTB

ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E.
General Editor: J. H. COSENS
Technical Editor: P. W. TUCKER, M.I.E.E.

12 OCTOBER 1956

In This Issue

645 INTERNATIONAL STANDARDS
647 WAKEFIELD "B" POWER STATION
653 MEASUREMENT OF RADIOACTIVITY
655 WORLD BANK'S FIRST DECADE
656 OVERSEAS REPRESENTATIVES
657 VIEWS ON THE NEWS
658 LETTERS TO THE EDITOR
660 PERSONAL AND SOCIAL
663 INDUSTRIAL NEWS
667 HIGH VOLTAGE IMPULSE TESTING OF TRANSFORMERS II
674 LIGHTING AND SOCIAL HISTORY
675 FUEL EFFICIENCY CONFERENCE
677 COLOUR TELEVISION RESEARCH
679 SMOKE ABATEMENT
680 GENERATION AND DEVELOPMENT
682 FINANCIAL SECTION
685 NEW ELECTRICAL EQUIPMENT
686 NEW PATENTS
687 NEXT WEEK'S EVENTS
688 CONTRACT INFORMATION

127 *CLASSIFIED ADVERTISEMENTS*
140 *INDEX TO ADVERTISERS*

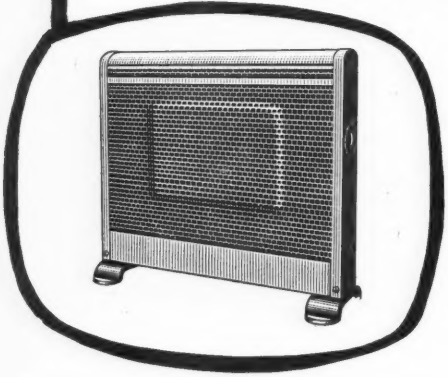
VOLUME 159 ◇ NUMBER 15

Eighty-Fourth Year of Publication

FRIDAY ◇ PRICE 1s 6d

Editorial, Advertising and Publishing Offices : Dorset House, Stamford Street, London, S.E.1. Telegraphic Address : "Elecrev, Sedist, London." Code : ABC. Telephone No. Waterloo 3333 (60 lines). Registered at the General Post Office as a Newspaper. Entered as Second Class Matter at the New York, U.S.A., Post Office. Annual Subscription : Home and Overseas £4 10s 0d : U.S.A. and Canada $14.00. Cheques and Postal Orders (on Chief Office, London) payable to ELECTRICAL REVIEW PUBLICATIONS LTD. and crossed "Lloyds Bank."

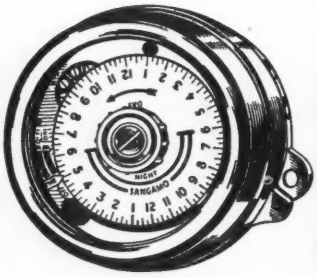
In time for autumn buying



Berry's Raydair Electric Radiator
will be seen in T.V. Shopping Magazines
on all Independent T.V. stations.

Be ready with Raydair—stock them—display them—sell them

Berry's **RAYDAIR** ELECTRIC RADIATORS



SANGAMO TIME SWITCHES

The superiority of Sangamo Time Switches, both in design and performance, has been established over more than twenty years of intensive world service. In addition to 24 hour-dial switches (as illustrated by a typical example, the Type SSZ), Solar Dial, Short Interval and Change-over types are also available. Advice and particulars of the entire range of Sangamo synchronous Time Switches will gladly be supplied on application.

SINGLE PHASE AND POLYPHASE WATTHOUR METERS

SYNCHRONOUS TIME SWITCHES

SYNCHRONOUS MOTORS AND MOTOR UNITS

SANGAMO WESTON

PANEL & SWITCHBOARD INSTRUMENTS
D.C. Moving Coil, A.C. Rectifier, H.F. Thermocouple, A.C./D.C. Moving Iron

PORTABLE INSTRUMENTS
D.C. Moving Coil, A.C. Rectifier, H.F. Thermocouple, A.C./D.C. Moving Iron, A.C./D.C. Dynamometer

LABORATORY STANDARD INSTRUMENTS
D.C. Moving Coil, A.C./D.C. Dynamometer

CURRENT TRANSFORMERS · FREQUENCY METERS · ALL-PURPOSE TEST SETS AIRCRAFT INSTRUMENTS · RATIOMETERS TACHOMETERS · WESTON STANDARD CELLS · ELECTRICAL THERMOMETERS "PHOTRONIC" PHOTO ELECTRIC CELLS PHOTOMETERS

SANGAMO WESTON LIMITED

ENFIELD · MIDDLESEX

Telephone: ENField 3434 (6 lines) & 1242 (6 lines) Grams: Sanwest, Enfield

Scottish Factory: Port Glasgow, Renfrewshire Port Glasgow 41151

Branches: London, CHAncery 4971
Glasgow, Central 6208; Manchester, Central 7904
Newcastle upon Tyne, Newcastle 26867
Leeds, Leeds 30867; Liverpool, Central 0230
Wolverhampton, Wolverhampton 21312
Nottingham, Nottingham 42403
Bristol, Bristol 21781
Southampton, Sa'ton 23328
Brighton, Brighton 28497

ELECTRICAL REVIEW

12 October 1956 Vol. 159 No. 15 Established 1872

International Standards

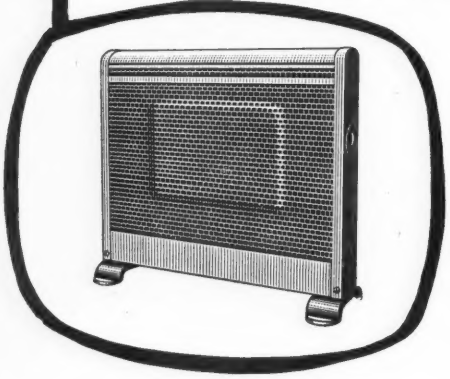
ABOUT two years ago the British Standards Institution set up an Export Panel, under the chairmanship of Mr. J. L. S. Steel (I.C.I.), to advise it how it could best assist British export trade. The Panel had a strong electrical representation, including Mr. D. Maxwell Buist (B.E.A.M.A.), Mr. Leslie Gamage (G.E.C.) and Mr. J. W. Ridgeway (Edison Swan), with Mr. Hector McNeil (Babcock & Wilcox). Naturally one of the main concerns of the Panel has been the extent to which British standards conform to the requirements of overseas customers—or, at least, to their national regulations. To this end British participation in, and influence upon, international standardisation, through the International Organisation for Standardisation (I.S.O.) and the International Electrotechnical Commission (I.E.C.), has been closely studied.

In a statement which it has recently issued the Panel mentions that while work on international standards has greatly increased in recent years there has been a parallel rapid growth of national standards. There has thus arisen a need for unification of basic requirements to reduce the disparities which are likely to handicap international trade. The Panel does not say, as it might have done, that in this matter, as in others, nationalism plays a strong part. Ostensibly standards are established to secure safe and satisfactory operation; but they have sometimes been used to protect a particular country's own manufacturers from foreign competition. Sometimes, too, national manufacturers have been able to persuade other countries to adopt their standards and thus have strengthened their hold upon these markets.

It is of particular concern to British manufacturers, who rely so much on export trade, that this "insularity" should be broken down, and the Panel calls for increased participation in the work of the I.S.O. and I.E.C. to ensure that the British point of view is properly presented. It fully supports the long-established policy of alignment of standards within the Commonwealth and does not consider this inconsistent with the effort to secure agreement on a wider front: in fact the Panel thinks that it will often be a prerequisite of this wider action.

The Panel advocates that fuller account should be taken in the preparation of British standards of practices overseas so that they may have a reasonable chance of adoption in international standards and thus gain a wider validity. It is recognised that there must be instances in which adherence to British standards is desirable for a number of reasons, but there are probably many more instances than are realised where we could bring our standards substantially into line with internationally agreed specifications or widely-accepted practices. Our competitive position could thus be improved, one consideration being that our specifications should not be more elaborate or rigorous than sound techniques require.

In time for autumn buying



Berry's Raydair Electric Radiator
will be seen in T.V. Shopping Magazines
on all Independent T.V. stations.

Be ready with Raydair—stock them—display them—sell them

Berry's **RAYDAIR** ELECTRIC RADIATORS

SANGAMO TIME SWITCHES

The superiority of Sangamo Time Switches, both in design and performance, has been established over more than twenty years of intensive world service. In addition to 24 hour-dial switches (as illustrated by a typical example, the Type SSZ), Solar Dial, Short Interval and Change-over types are also available. Advice and particulars of the entire range of Sangamo synchronous Time Switches will gladly be supplied on application.

SINGLE PHASE AND POLYPHASE WATTHOUR METERS
SYNCHRONOUS TIME SWITCHES
SYNCHRONOUS MOTORS AND MOTOR UNITS

SANGAMO WESTON

PANEL & SWITCHBOARD INSTRUMENTS
D.C. Moving Coil, A.C. Rectifier, H.F. Thermocouple, A.C./D.C. Moving Iron
PORTABLE INSTRUMENTS
D.C. Moving Coil, A.C. Rectifier, H.F. Thermocouple, A.C./D.C. Moving Iron, A.C./D.C. Dynamometer
LABORATORY STANDARD INSTRUMENTS
D.C. Moving Coil, A.C./D.C. Dynamometer

CURRENT TRANSFORMERS · FREQUENCY METERS · ALL-PURPOSE TEST SETS AIRCRAFT INSTRUMENTS · RATIOMETERS TACHOMETERS · WESTON STANDARD CELLS · ELECTRICAL THERMOMETERS "PHOTRONIC" PHOTO ELECTRIC CELLS PHOTOMETERS

SANGAMO WESTON LIMITED
ENFIELD · MIDDLESEX
Telephone: ENField 3434 (6 lines) & 1242 (6 lines) *Grams:* Sanwest, Enfield

Scottish Factory: Port Glasgow, Renfrewshire
Port Glasgow 41151
Branches: London, CHAncery 4971
Glasgow, Central 6206; Manchester, Central 7904
Newcastle upon Tyne, Newcastle 26867
Leeds, Leeds 30867; Liverpool, Central 0330
Wolverhampton, Wolverhampton 21912
Nottingham, Nottingham 42403
Bristol, Bristol 21781
Southampton, Sa'ton 23328
Brighton, Brighton 28497

ELECTRICAL REVIEW

12 October 1956 Vol. 159 No. 15 Established 1872

International Standards

ABOUT two years ago the British Standards Institution set up an Export Panel, under the chairmanship of Mr. J. L. S. Steel (I.C.I.), to advise it how it could best assist British export trade. The Panel had a strong electrical representation, including Mr. D. Maxwell Buist (B.E.A.M.A.), Mr. Leslie Gamage (G.E.C.) and Mr. J. W. Ridgeway (Edison Swan), with Mr. Hector McNeil (Babcock & Wilcox). Naturally one of the main concerns of the Panel has been the extent to which British standards conform to the requirements of overseas customers—or, at least, to their national regulations. To this end British participation in, and influence upon, international standardisation, through the International Organisation for Standardisation (I.S.O.) and the International Electrotechnical Commission (I.E.C.), has been closely studied.

In a statement which it has recently issued the Panel mentions that while work on international standards has greatly increased in recent years there has been a parallel rapid growth of national standards. There has thus arisen a need for unification of basic requirements to reduce the disparities which are likely to handicap international trade. The Panel does not say, as it might have done, that in this matter, as in others, nationalism plays a strong part. Ostensibly standards are established to secure safe and satisfactory operation; but they have sometimes been used to protect a particular country's own manufacturers from foreign competition. Sometimes, too, national manufacturers have been able to persuade other countries to adopt their standards and thus have strengthened their hold upon these markets.

It is of particular concern to British manufacturers, who rely so much on export trade, that this "insularity" should be broken down, and the Panel calls for increased participation in the work of the I.S.O. and I.E.C. to ensure that the British point of view is properly presented. It fully supports the long-established policy of alignment of standards within the Commonwealth and does not consider this inconsistent with the effort to secure agreement on a wider front: in fact the Panel thinks that it will often be a prerequisite of this wider action.

The Panel advocates that fuller account should be taken in the preparation of British standards of practices overseas so that they may have a reasonable chance of adoption in international standards and thus gain a wider validity. It is recognised that there must be instances in which adherence to British standards is desirable for a number of reasons, but there are probably many more instances than are realised where we could bring our standards substantially into line with internationally agreed specifications or widely-accepted practices. Our competitive position could thus be improved, one consideration being that our specifications should not be more elaborate or rigorous than sound techniques require.

POWER STATION DESIGN

The 240 MW Wakefield "B" generating station, which is described in this issue, is unusual in a number of respects. In the first place the whole of the design and construction work, civil, mechanical, and electrical, has been carried out by the Construction Department of the Yorkshire Division of the Central Electricity Authority and no outside consultants have been employed. The average price per kW of installed capacity in base load generating stations is, at the present time, about £70. By careful design the price of Wakefield "B" is working out at something under £50/kW, which is an achievement upon which those concerned are to be congratulated. The station is by no means a "utility" version of the more usual C.E.A. installations although it is by far the most compact now under construction, with a building capacity of 28·7 cu ft/kW. What the designers have done, right from the outset, is to face the fact that what they are building is an industrial plant and not a penny has been wasted on unnecessary embellishments. Despite this the station has a most pleasing appearance both outside and inside. As regards the plant itself many things have been done to lower costs without reducing reliability or making operation difficult; in fact, the reverse applies. Typical of the things which have been done is the elimination of all variable-speed drives, except where absolutely necessary, and the reduction of continuous coal weighers from one per boiler bunker to one which can be used in conjuction with any bunker as desired.

BOILER FOULING

The effects of burning pulverised coals having high chlorine content on the rate of formation of hard deposits on high-temperature boiler surfaces are normally difficult to assess without protracted trials on full-scale plant. Results of research with pilot installations described by Messrs. W. G. Marskell and J. M. Miller (Babcock & Wilcox) in the *Journal* of the Institute of Fuel (September) appear to offer an economic and flexible means of shortening the process and to make for a clearer understanding of the mechanism of combustion. Conclusions reached by the authors are that chlorine content is important in itself (the presence of hydrochloric acid in the flue gas exercising an appreciable influence) and that the sulphur-chlorine ratio is not a sufficiently reliable index of potential fouling troubles. Both recirculation of flue gas and humidification of combustion air promise well, subject to certain conditions.

EUROPEAN FREE TRADE

Many considerations arise for British industry in the proposals for a common European market and partial free trade area which Mr. Macmillan, the Chancellor of the Exchequer, seems to regard with some favour. Broadly it is thought that a "home" trade based on an extensive free trade area would enable Europe to face the United States and Russia in foreign markets on more equal terms. If Great Britain were a member of the group European markets would become more accessible to us but so also would the British market to European manufacturers. Some authorities believe that such an arrangement would spur British manufacturers to produce goods at more competitive prices but they take little account of differences in labour conditions. Reduction of prices depends equally upon the efforts of employers and workers. As foodstuffs would apparently be excluded from any agreement in which this country might be involved, Imperial preference would not be greatly affected, although Canada from whom we import some manufactured goods might have objections. There are a number of other factors which the British electrical industry, in common with others, will have to study.

CALDER HALL

Next week's *Electrical Review* will be a special issue containing a fully-illustrated detailed description of the Calder Hall atomic power station which the Queen is to open on Wednesday next

IMPULSE TESTING

The articles on "Impulse Testing of Switchgear" by Mr. H. F. Jones (17th August issue) and "High Voltage Impulse Testing of Transformers" by Mr. G. H. Hickling (Part I, 31st August; Part II, this issue, page 667) show the apparatus and techniques relevant to different fields of application and, secondly, focus attention on a subject which we feel is little understood.

It is true, as Mr. Hickling says, that impulse testing has been recognised for over 20 years as a proper method of ensuring that power transformers are correctly designed and built to withstand the abnormal insulation stresses set up under system surge conditions. But it is also true, as Mr. Jones says, that insulation is a major factor in the design, capital cost and operation of a transmission system and the associated equipment which may be exposed to atmospheric or internally produced over-voltages.

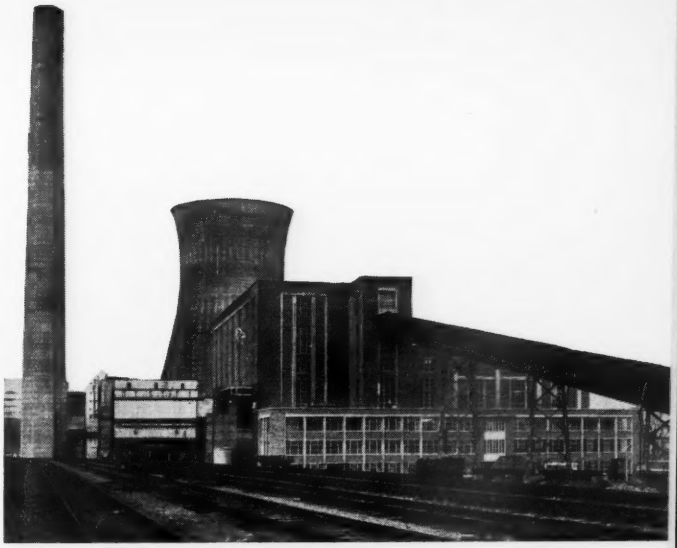
Here then we must return to Mr. Hickling's article where he says "A British Standard defining the principles of impulse testing appeared in 1940, following recommendations published two years earlier by the International Electrotechnical Commission, but as yet no such Standard has been issued defining specific tests to be applied to transformers or other plant."

APPLYING THE REGULATIONS

Although the 13th edition of the I.E.E. Regulations is in its more logical arrangement and greater simplicity of phrasing a big improvement on its forerunners, some of its practical implications are not always easy to grasp immediately by those engaged on the more practical side of installation work. This is an inevitable consequence of the formulation of a code that has to be designed to cover every contingency as far as humanly possible and perhaps to stand up to legal scrutiny. One of the chief merits of the A.S.E.E. Guide (reviewed last week) lies in the saving of time in many instances through a more direct interpretation of what is essential to secure the high standard of safety that results from good installation practice.

WAKEFIELD 'B'

Progress on 240 MW Base Load Station



WITHIN the next month or so the third of the four 60 MW turbo-alternator/boiler units which are being installed in Wakefield " B " generating station will be put into commission and it is expected that the complete plant will be in full operation in about nine months' time. The station is situated on the south bank of the River Calder, between the river and the main Wakefield-Doncaster road just over one mile from the centre of Wakefield. Immediately to the west of the station site is the British Railways main line.

Site work was first started in June, 1952, and levelling and preparation of the site continued during the remainder of that year. Meanwhile, the main foundation contract was let and work began in December, 1952. Since that time work on the whole of the station has progressed very rapidly and it is interesting to note that the design work, civil, mechanical, and electrical, has been carried out by the Construction Department of the Yorkshire Division of the Central Electricity Authority.

The foundations throughout the turbine house and boiler house are direct on the rock which outcrops at the rear of the boiler house and slopes down through the turbine house. Full use was made of this natural slope to locate cooling water culverts without the need to excavate rock. The foundations for the turbine house electrical annexe and the service block are supported on piles which extend down to rock at a depth of roughly 20ft below finished floor level.

Constructional Features

The overall dimensions of the main building are 298ft by 298ft by 133ft high, and the accommodation building is a three-storey structure 244ft long by 42ft wide by 44ft high. The turbine house is 110ft by 298ft by 84ft high and its framework and roof are constructed of reinforced concrete. It consists of nine bays 32ft 6in long and spanning 106ft 9in from centre to centre of columns; the structure supports a 125 ton travelling crane. The roof is of the barrel-vaulted type 2¾in thick, the beams between the barrels being pre-stressed and post-tensioned on the Magnel-Blaton system. The whole of the elevation is of panel wall contruction. The main framework projects and is partly exposed as an architectural feature having vertical lines formed by simple shapes in shuttering. The boiler house is of steel framed construction 85ft by 264ft by 133ft high and maintains the panel design, the main framework being encased on the outside in cast *in situ* concrete tied to the steelwork.

This station, one of the most compact now under construction, has a building capacity of only 28·7 cu ft/kW. Apart from this the price of the station has, by careful design, been kept well down and the cost per kW of plant installed is under £50.

For fuel the station uses coal which may be delivered either by road or rail and provision is made for handling sufficient coal to maintain the output of the four 60 MW sets running at 100 per cent load factor for 24 hours with coal handling being carried out on a normal day-work basis. The coal handling plant is designed for a rail intake of 2,500 tons a day and road deliveries up to 1,000 tons a day. For handling rail traffic five miles of track have been laid out including nine standage and two tippler sidings. Wagons are gravity shunted to the tippler sidings, and from there movement is by Strachan & Henshaw electrically driven " beetles " to the two side discharge tipplers of the same make, each of which incorporates automatic weighing equipment and is capable of handling hourly 20 wagons of up to 24 tons capacity.

The coal is discharged into 35 tons capacity receiving hoppers where it is screened through a 3¼in by 7½in mesh grid, after which it passes down on to vibrating feeders connecting with the main conveyor belt system. Road-borne coal can be tipped into either of two 25 tons capacity receiving hoppers or direct on to the 80,000 tons capacity storage area.

From the receiving hoppers duplicate belt conveyors of 200 tons/hr capacity take the coal up an inclined and enclosed gantry to the boiler house bunkers. Each bunker has a capacity of 900 tons which is sufficient for 30 hours' steaming at maximum continuous rating. From the rail receiving hoppers further conveyors take coal to the storage area where it is discharged by a radial boom conveyor and consolidated by bulldozers. Duplicate conveyors are also installed for reclaiming coal from the storage area and transferring it to the boiler bunkers at the rate of 200 tons/hr each. Coal crushers are provided to deal with roadborne coal from local sources and full provision is made for automatic coal sampling with means of mechanical return of excess sampling material to the conveying system.

From the boiler bunkers the coal passes on to the rotating table of one of the two feeders serving each pulverising mill. For each boiler unit there are two Foster Wheeler type D7 23 tons/hr capacity ball mills, each serving four burners there being two exhausters for each mill. The arrangement is such that even combustion can be obtained with either one, or both, or any number of exhausters working and the mills are capable of maintaining the

maximum continuous rating of the boiler with one exhauster out of service on normal fuel. The mills are of the double classifier type in which the coal and hot air enter each end of the mill and the pulverised fuel leaves at both ends of the mill in suspension. This arrangement has the advantage of pre-drying the coal before entry into the mill. Each pair of mills feeds the eight front wall mounted turbulent burners fitted to each boiler.

Ash and dust handling plant is provided and is of the high-pressure sluicing and pumping type. It is designed to remove the clinker ash from the boiler ash hoppers and also the dust from the six electrostatic precipitator hoppers and three economiser hoppers of each boiler, as well as from the dust hopper in the chimney base and the vacuum cleaning plant receiver. The plant is designed to remove up to 120 tons of dust and 30 tons of ash from each of the four boilers in turn within a working period of 7 hours.

Each boiler has an ash hopper of sufficient capacity to enable the boiler to steam at 90 per cent load factor (54 MW output) for 24 hours without the ash hopper being emptied. Ash from the dry type hopper beneath each boiler is quenched and then sluiced by high-pressure water jets to crushers over the ash sump. Dust is collected from the precipitator, economiser and chimney hoppers and conveyed by means of hydro-vactors and a sluicing system to the same ash sump. Two 245 h.p. high-pressure sluicing pumps are provided, together with two 175 h.p. main ash pumps. From the sump the ash and dust is pumped via duplicate ash lines to the ash settling ponds to the east of the station where the surplus filtered water is allowed to drain back to the river. As it is ultimately intended to extend the ash line, provision has been made for the installation of booster ash pumps when the ash may be pumped over a distance of about 2½ miles. To accommodate the quenching water an overflow chamber of 50,000 gal capacity is provided in the ash sump. This avoids having to run the ash pumps continuously to deal with quenching water.

Steam-Raising Plant

The four Foster Wheeler boiler units are each designed to supply 550,000 lb/hr of steam at 950 lb/sq in and 925 deg F. Each boiler with its turbine operates on the unit principle. The steam temperature control is provided over the range of 80 to 100 per cent m.c.r. when the feed water temperature is 385 deg F and the ambient air temperature is 80 deg F. Firing is from eight burners arranged in two rows of four on the front combustion chamber wall.

Each boiler is a single drum water tube type unit having natural circulation and the boiler, furnace, superheater and economiser are of self-contained construction carried on a supporting structure independent of the boiler house building framework. The design embodies a large water-cooled combustion chamber with a water-cooled dry bottom and a large proportion of the heating surface consists of vertical tubes placed in the combustion chamber. Saturated steam is taken from the drum to the superheater through vertical tubes which form a wall at the rear of the superheater cavity. Similarly, the feed from the economiser is an integral part of the boiler and passes to the two top headers via riser tubes which also form a cooling wall for the superheater cavity. From these headers the feed is taken externally to the drum.

The gases from the combustion chamber cross rows of 3¼in o.d. tubes on a 14in pitch and then pass over the sections of the superheater and on through the economiser, the Ljungstrom air heaters and the two Sturtevant electrostatic precipitators to the i.d. fans and so to the chimney.

To ensure separation of moisture from the saturated steam and thereby limit the solids carried over to the superheater, the drum has internals which include a system of horizontal centrifugal separators and transverse chevron driers fitted to each side of the drum. Separation is carried out in two stages, the water in the first stage being removed by a drain and discharged above the normal water level, while the steam passes to the second stage driers. The boiler fittings include pressure gauges, two Cope's feed water regulators, high and low water alarms, local water level gauges, Igema remote water level indicator, boiler water sampling equipment, blow down valves, stop valves and isolating non-return valve, feed check valves and safety valves fitted with silencers; one of the safety valves is electrically assisted.

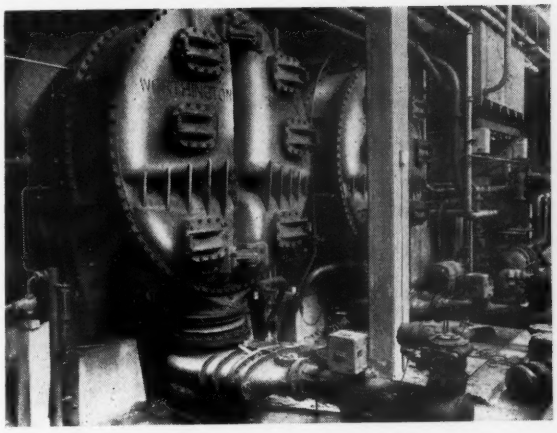
There are two induced draught and two forced draught fans on each boiler and these are remotely controlled from the unit panel. The f.d. fans are driven by constant speed motors through flexible couplings, while the i.d. fans are driven by either a high-speed or (more usually) a low-speed motor mounted at either end of the same shaft. The low-speed drive is through a flexible coupling while the high-speed drive is through a clutch which performs the function of breaking the connection between the fan and the high-speed motor when running on the low-speed motor.

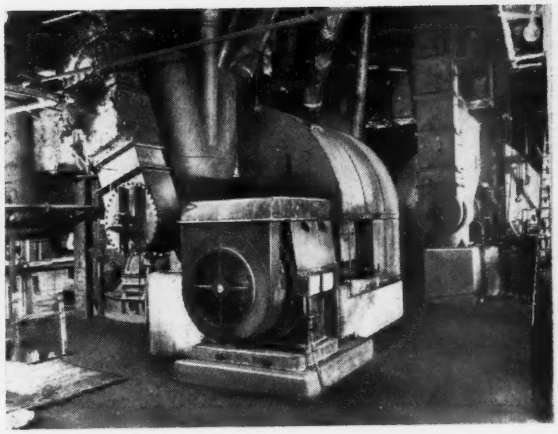
Each boiler is equipped with automatic sequence controlled soot blowers supplied by Clyde Blowers, Ltd., and these comprise four retractable furnace blowers, four retractable blowers in the secondary superheater, two retractable blowers for the furnace and secondary superheater, and four retractable and four non-retractable blowers in the primary superheater. There are also four locally controlled air heater soot blowers and provision has been made to fit economiser soot blowers if found necessary.

Boiler Control

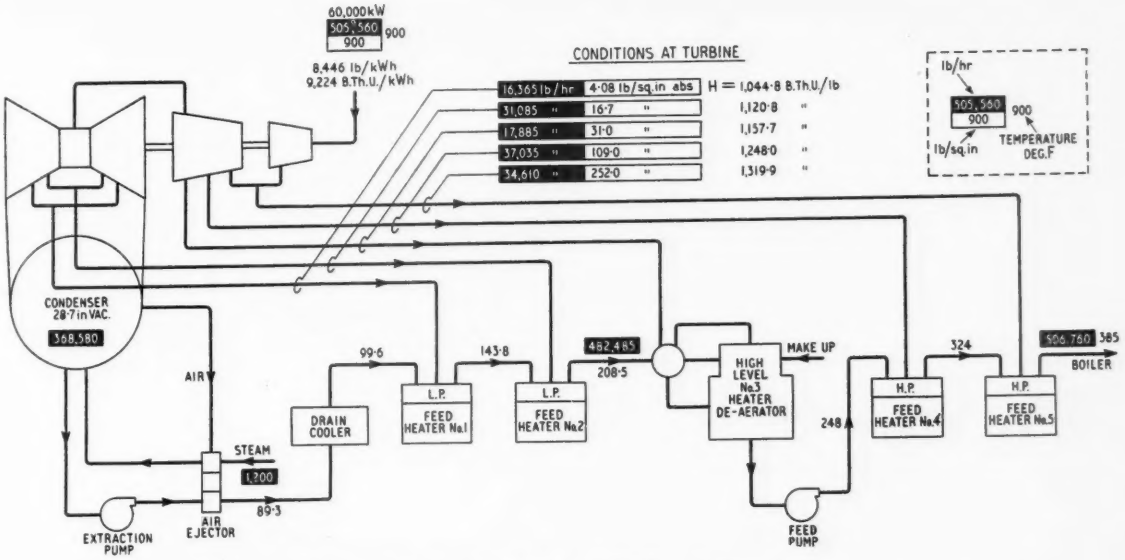
Control of the final steam temperature is effected by two contact type de-superheaters with associated equipment which by-passes part of the superheated steam from the primary superheater around the de-superheaters. The steam mixture passes to the secondary superheater for the final superheating stage. Automatic control of the final temperature is linked with the automatic combustion control system and is operated by compressed air at 50 lb/sq in. The Hagan combustion control system as manufactured by James Gordon & Co., Ltd., is employed. This is a pneumatic type of control, but all instruments are operated electrically from the various measuring points. The essential features of the system are a master steam pressure regulator, which provides a major control impulse, a combustion air regulator to maintain the correct steam/air flow balance, and a furnace pressure regulator to maintain a constant suction in the combustion chamber under all conditions. The equipment is designed to maintain the steam pressure within 15 lb/sq in of the normal 950 lb/sq in at m.c.r. down to 25 per cent of m.c.r., while maintaining efficient combustion over this range of load.

The signal from the master steam pressure regulator passes directly or indirectly through compensating or transforming relays to controllers for the mill output dampers, i.d. and f.d. fan vanes and steam temperature control system. Flow measuring elements in the steam main to the turbine also transmit signals to the transforming relays and modify the signal from the master pressure regulator to take care of differences in steam flow due to varying load demand on the turbine. The mill output is controlled by dampers in the fuel pipe to each exhauster, the damper being tripped automatically should the differential pressure on its associated exhauster fall below a set value. Purge dampers interlocked with the mill output

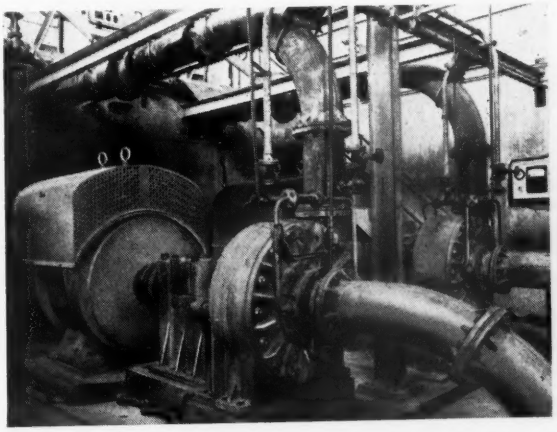




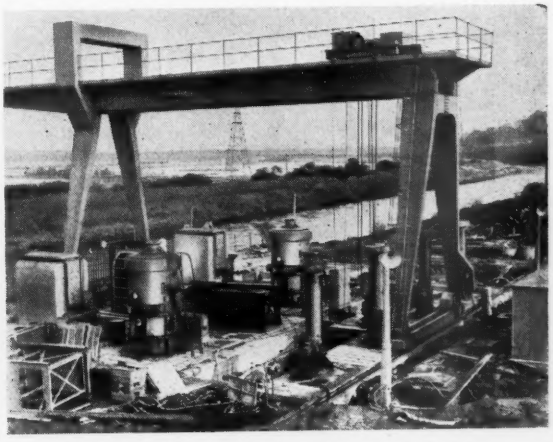
Left: Two Worthington Simpson three-pass condensers serve each turbine. Right: For each boiler there are two Foster Wheeler 23 tons/hr ball mills



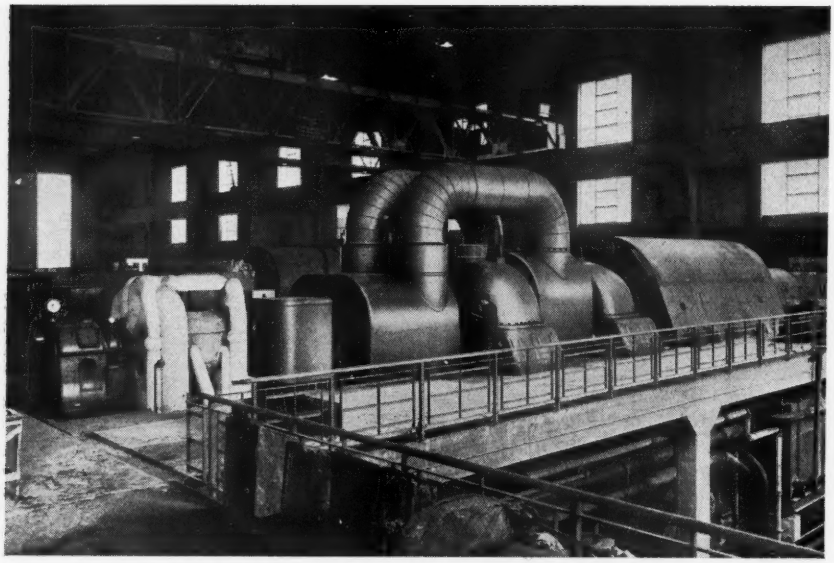
Heat balance diagram for 60 MW set at maximum continuous rating



Two 175 h.p. main ash pumps deliver ash to the settling ponds



The four main c.w. pumps are outdoors at the riverside



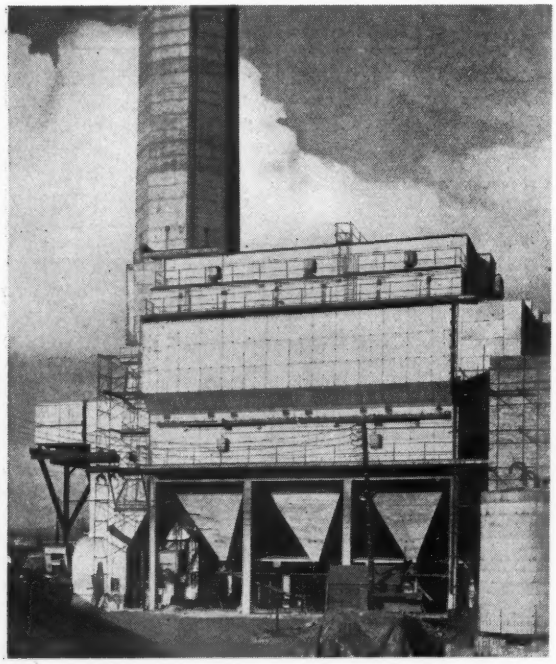
One of the completed 60 MW turbo-alternator sets

dampers then open and allow air to purge the coal/air mixture into the boiler, thus guarding against a blow-back in the fuel pipes. The output dampers to each mill, together with the hot air inlet damper, may be tripped simultaneously in emergency from a trip button on the boiler panel thus isolating the mill completely from the boiler.

Turbo-Alternators

The four 60 MW 3,000 r.p.m. turbo-alternator sets are being supplied by the English Electric Co., Ltd. They are designed to operate with steam at 900 lb/sq in and 900 deg F at the turbine stop valves and feed heat in five stages to 385 deg F at full load with a vacuum of 28·7in of mercury. They are of three-cylinder construction with seventeen impulse stages in the h.p. cylinder, fourteen impulse stages in the i.p. cylinder, and one impulse stage and seven reaction stages in each half of the double flow h.p. cylinder. The guaranteed steam and heat consumptions at 60 MW are 8·446 lb/kWh and 9,224 B.Th.U/kWh.

The h.p., i.p. and l.p. casings are secured together to form a complete unit anchored securely at the supporting feet of the l.p. casing. All pedestals are free to slide, allowing expansion towards the h.p. end. Axial alignment is maintained by axial keys while radial expansion is permitted by the use of key paws on each cylinder. The three turbine rotors and the alternator rotor are connected by multi-tooth flexible couplings and each turbine is provided with its own Michell thrust block. The h.p. and i.p. rotors are provided with means of adjusting the thrust blocks axially to absorb the effects of differential axial expansion.



View of the precipitators showing the dual-motor drive for one of the i.d. fans

The main oil pump is driven from the turbine shaft and a full duty a.c. motor driven auxiliary oil pump is arranged to start automatically when the relay oil pressure falls below a predetermined limit. An a.c. motor driven flushing oil pump and a jacking pump are used in conjunction with the barring gear. A d.c. oil pump gives an emergency supply for lubricating only. Three 50 per cent capacity oil coolers are installed for each set using circulating water as the cooling medium. The governor gear is of the standard English Electric centrifugal totally enclosed type driven by the turbine shaft through single helical gearing. It controls a primary oil relay, which in turn, operates a secondary oil relay at each of the two throttle valves and so opens or closes these in accordance with change in speed. Two emergency governors are fitted to the h.p. turbine shaft and are set to shut off steam should the speed of the turbine exceed the normal by a predetermined amount. Devices are fitted which automatically reduce load in the event of the inlet steam pressure falling below a predetermined point or when the pressure in the condenser rises above a certain limit. Steam is admitted to the turbine through two emergency stop valves and two governing valves arranged on either side of the machine.

The shaft glands are steam packed and are of the labyrinth type. Sealing steam can be supplied to all glands during starting up and low load periods but during normal running the glands are interconnected to give sealing independent of the live steam supply.

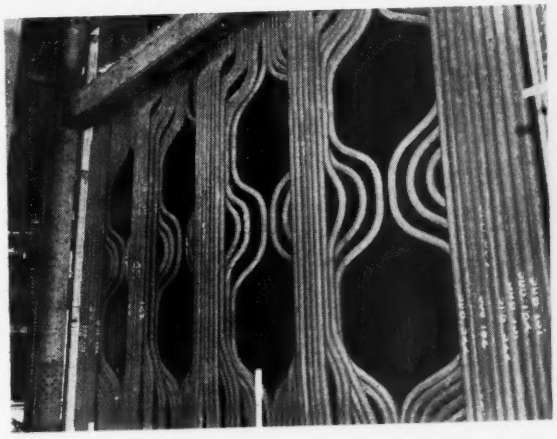
There are two Worthington Simpson three-pass condensers for each machine with a balance pipe between them, the total cooling surface being 55,000 sq ft and the normal cooling water requirement is 40,000 gal/min. Air and other incondensible gases in the condenser are removed by two 100 per cent duty three-stage air ejectors, there also being one quick-start air ejector for each machine. The three-stage units are condensate cooled and each is supplied with steam at boiler pressure from the auxiliary steam manifold. The steam consumption of each main

ejector is 1,200 lb/hr, while the quick-start ejector uses 2,500 lb/hr of steam and will produce an absolute back-pressure of 10in Hg in five minutes.

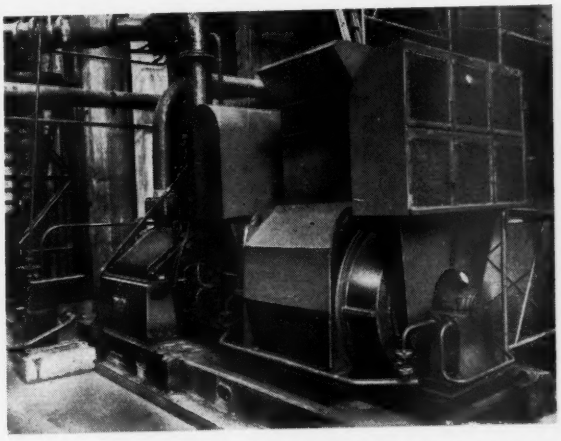
The two 100 per cent duty extraction pumps are each driven by a 158 h.p. 3·3 kV 975 r.p.m. motor and when working against a head of 304ft 770 gal/min of condensate is dealt with by each pump. The feed heating train consists of four surface heaters and one high level series type de-aerator heater. Condensate is pumped from the condenser at 87 deg F by either extraction pump and is fed through one air ejector, drain cooler and two l.p. heaters to the high level de-aerator heater. From here it passes through a feed pump to the two h.p. heaters and then to the boilers. The drains are cascaded back and pass through the drains cooler before entering the condenser. Make-up is introduced by injection into the de-aerator.

There are three 100 per cent duty electrically driven multi-stage centrifugal feed pumps for each pair of boilers, one acting as standby and two as worker pumps. Supplied by Mather & Platt, Ltd., each is horizontally mounted and directly coupled to a 1,440 h.p. 2,960 r.p.m. 3·3 kV squirrel cage induction motor. The pumps are designed to run in parallel and have characteristics which fall as the quantity is increased from zero to full duty. At a load of 60 MW the temperature at the feed pump suction is 248 deg F, while the pressure is 36 lb/sq in. Each pump is capable of delivering 650,000 lb/hr at a pressure of 1,256 lb/sq in.

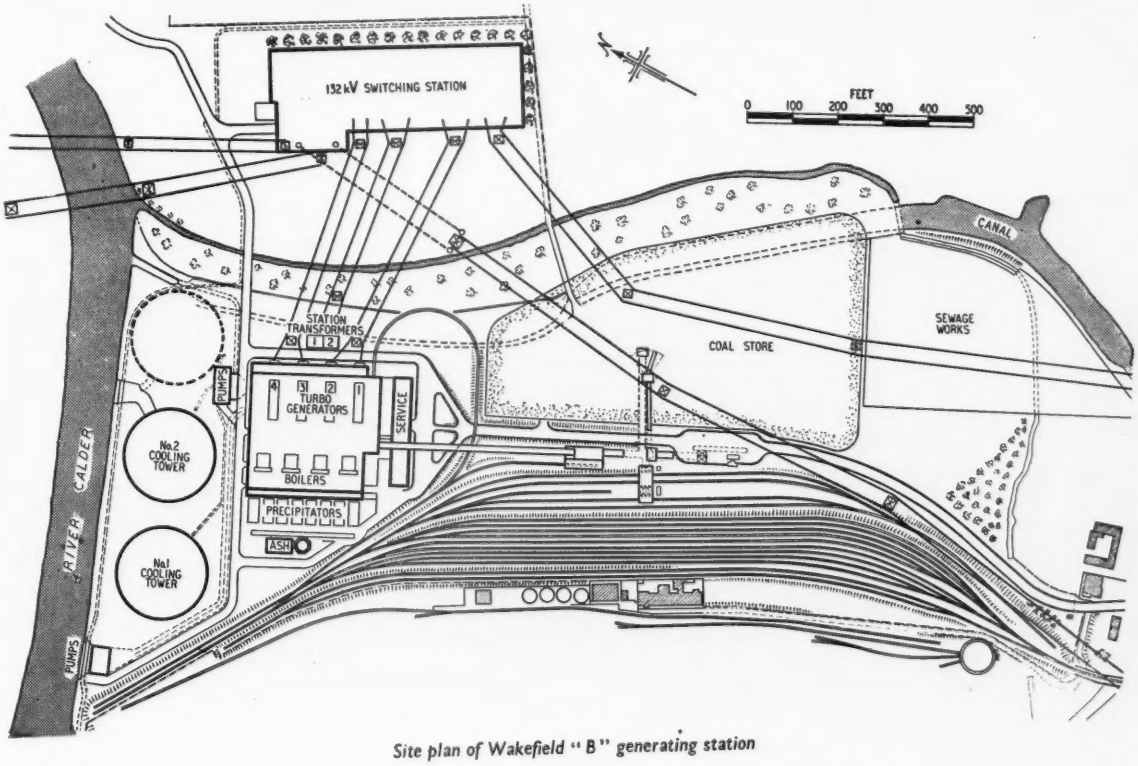
The boiler feed consists of condensate plus a small per-



Burner positions in one of the boilers during construction



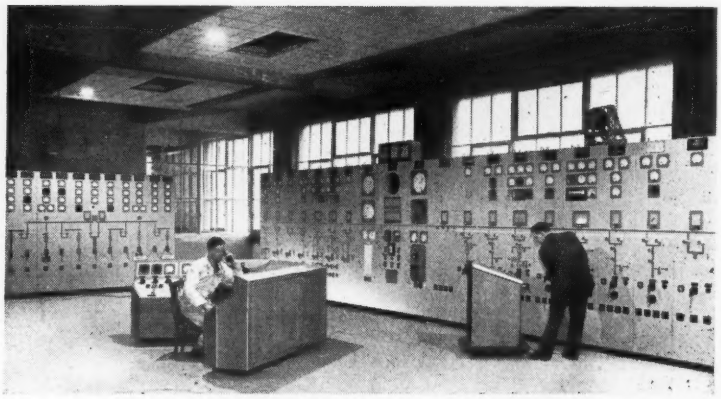
Three electrically driven feed pumps serve each pair of boilers



Site plan of Wakefield "B" generating station

centage of make-up. To ensure that all make-up water is pure, town water is first treated in a Permutit base exchange softener and then evaporated in central live steam evaporators supplied by Aiton & Co., Ltd. Space is provided for a third evaporator if this is found necessary at a later date, dependent on whether the station is operated on single- or two-shift working.

The water softener is designed to reduce the make-up water to zero hardness at a normal continuous rate of 6,000 gal/hr and it is suitable for feeding direct to the two live steam evaporators serving the 240 MW of plant in the station. The triple effect evaporators are supplied with live steam at 900 lb/sq in and 900 deg F to the thermo-compressor, which draws vapour from the third effect, the incondensible gases being then vented to atmosphere.



The control room overlooks the turbine room so that the engineers can see all four units

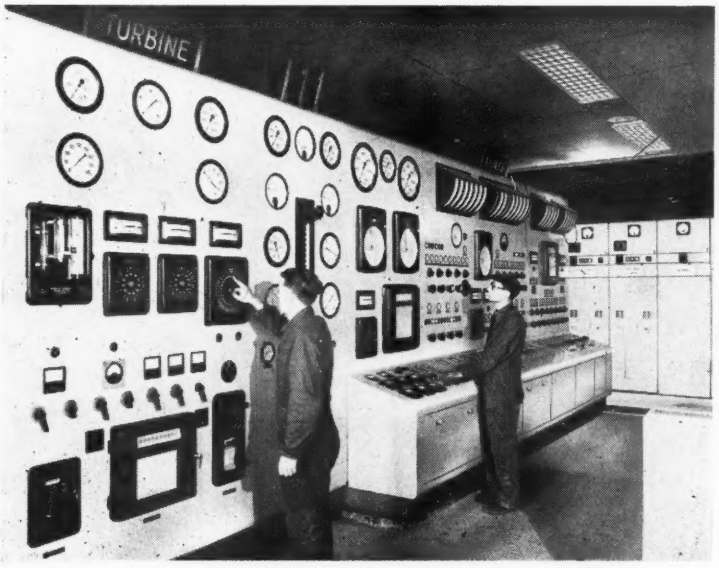
Circulating water for cooling the condensers is pumped from the River Calder at an upstream riverside pumping station and returns to the river at a downstream outlet. The discharge to the river is via a seal pit which ensures the correct hydraulic conditions to give a high efficiency of syphonic recovery, and so minimise pumping losses. The total quantity of cooling water required for the four sets is over 10 million gal/hr. Two cooling towers will supplement the cooling during periods of low river flow or high atmospheric temperature, and will be capable of parallel operation in order to distribute the heat burden evenly between them. The towers are of the reinforced concrete natural draught hyperbolic type 280ft high, and each is designed to cool up to $3\frac{3}{4}$ million gallons of water an hour. When completed, the towers will be served by three pumps of 42,000 gal/min capacity. A catchment storage trough of 15,000 gal capacity is provided inside and approximately 20ft from the top of each tower to give h.p. water supply to the fire fighting system.

Space is available for the construction of a third cooling tower should this be found necessary after a period of operation, in order to meet conditions laid down following a public inquiry in January, 1953.

There are four 100 per cent duty 44,000 gal/min cooling water pumps at the riverside which serve the mixed river and cooling tower system, the return water from the cooling towers being via the river, flowing upstream into the river intake. No housings are provided for the pumps, which are of the outdoor type as can be seen from the accompanying illustration.

The 60 MW, 11·8 kV, hydrogen-cooled alternators and the gear driven 1,005 r.p.m. air-cooled exciters and pilot exciters are of English Electric manufacture. Circulation of both hydrogen and air is by means of fans mounted integrally with the rotor and exciter shafts. The designed hydrogen pressure is 0·5 lb/sq in but this can be raised to 15 lb/sq in as a maximum. Heat is transferred to the river water in two stages. In the primary cooling stage one of the two motor-driven vertical spindle centrifugal pumps, running at 1,450 r.p.m. and capable of delivering 750 gal/min against a head of 35ft, pumps distilled water through a closed loop formed by the gas coolers and two surface type heat exchangers. In the secondary stage river water passes from the cooling water inlet culvert through strainers and the heat exchangers to the cooling water outlet culvert. The distilled water extracts heat from the hydrogen in the gas coolers and transfers it to the river water in the heat exchangers. Excessive leakage of hydrogen between rotor shaft and stator frame is prevented by oil seals at each end of the stator casing. The oil supply to the seal rings is delivered through a small cooler by a motor driven pump, the pressure at the seal being automatically maintained at about 10 lb/sq in above the gas pressure in the alternator. A standby pump is installed which is arranged to start up automatically if the oil pressure falls. After passing through the gland seals the oil is caught in chambers at each side of the seals. The oil from the hydrogen side is taken to tanks where foam is allowed to settle out and then passes to a vacuum treating unit which removes entrained gases and water before recirculating the oil back to the seals. The oil from the air side drains directly into a reservoir which forms part of the seal oil unit.

The main exciter and pilot exciter are



There are two boiler/turbine control rooms containing two unit control panels and desks

built into a single frame and are gear driven at 1,005 r.p.m. The voltage regulation is by Metro-Vick normally inactive type V.S.A. equipment which will hold the voltage to within ±5 per cent.

An unusual feature is the connection between the alternator terminals and the 72 MVA transformer. This connection is of box angle copper sections with flexible connections to 4,000 A trough bushings in the transformer cubicle rear wall. The 6 MVA 11·8/3·45 kV unit transformer is teed off adjacent to the alternator connection, bolted links being provided for disconnection for test purposes. These main connections are encased in a reinforced concrete tunnel which is pressurised by an external motor driven fan.

The generator transformers are situated in outdoor cells on the north-east wall of the main station building, being connected by overhead lines to the 132 kV grid switching station nearby. Power for auxiliaries is normally provided by the unit transformers but as an alternative and for starting-up the plant initially and after a complete shutdown, there are two 10 MVA 132/3·45 kV station transformers which receive their supply from the grid substation and are connected on the l.v. side to the 3·3 kV station busbars. The generator and station transformers were supplied by the English Electric Co., Ltd., while the unit transformers are of Yorkshire Electric Transformer Co., Ltd.'s manufacture. Fire protection is provided for all transformers by the "Mulsifyre" system of Mather & Platt manufacture.

Unlike most modern stations the main control room is arranged to overlook the turbine room. It is situated half way along the north-east wall of the turbine room about 12ft above the turbine floor level and through the two large plate glass windows the control engineers can see all four sets, and boilers. Windows on the outer wall provide a good view of the exterior of the station and switching site. Each of the two boiler/turbine control rooms contains two unit control panels and two desks. One desk is for the turbine operator and carries alarm facias for two turbines and common services. Normal staffing arrangements will be one turbine operator supervising two turbines. The other desk is for a boiler operator, and carries alarm facias for two boilers. Indicating instruments to show conditions on the boiler oil firing ring main system are also on this latter desk. Each desk is also fitted with telephones for communication to auxiliary plant attendants, and for general purposes.

The design and development involved in building this station has been carried out entirely by the construction department of the Yorkshire Division of the Central Electricity Authority with Braithwaite & Jackman of Leeds as executive architects.

The main contractors are:—Civil engineering works, George Wimpey & Co., Ltd., Mitchell Construction Co., Ltd., Holst & Co., Ltd., D. Long & Co., Ltd., and M. J. Gleeson, Ltd.; boilers, Foster Wheeler, Ltd.; turbo-alternators, English Electric Co., Ltd.; condensing plant, Worthington Simpson, Ltd.; ash and dust handling plant, Babcock & Wilcox, Ltd.; coal handling plant, R. Dempster & Sons, Ltd.; 3·3 and 132 kV switchgear, Reyrolle & Co., Ltd.; 415 V switchgear, General Electric Co., Ltd.; main cabling, Drake & Gorham, Ltd.

Acknowledgment is due to Mr. G. A. Vowles, divisional controller, Yorkshire Division, Central Electricity Authority, for permission to publish this article, and to Mr. F. Barrell, generation engineer (construction), Yorkshire Division, for the assistance which he gave us in the preparation of the material.

MEASUREMENT OF RADIOACTIVITY

I.E.E. Measurement and Control Section Chairman's Address

WHEN he delivered his inaugural address as chairman of the Measurement and Control Section of the Institution of Electrical Engineers in London this week, Dr. Dennis Taylor (A.E.R.E., Harwell) gave an interesting account of the techniques of measuring radioactivity which he began by explaining the basis of measurement. He said that a radioactive substance disintegrated with the emission of nuclear particles and/or photons, and the disintegration rate, which might be determined by measuring the rate of particle (or photon) emission, was decided by the amount of radioactive material present in the sample under investigation and by its half-life. Hence, measurement of the emission rate provided a convenient method for the assay of such materials.

A measuring instrument for radioactive assay involved many design problems and illustrated most of the fundamental conditions for satisfactory measurement. As an example Dr. Taylor chose an instrument for the continuous monitoring of α-active material in solution in the presence of γ- and β-active matter also in solution. It consisted of a scintillation counter, a liquid-sampling device and a system of standardising against a standard radioactive source. The chairman described the arrangement in detail and said that in practice instruments of this sort gave long periods of satisfactory service, and difficulties where they had occurred had been mostly confined to the problem of presenting a representative sample of the active liquor to the measuring head. The liquid-sampling device shown therefore needed modification and elaboration in some cases.

In practice the ultimate sensitivity was determined very largely by the background counting rate, reduction of this rate allowing higher sensitivity. Reduction of background counting rate might be achieved by using special counters which had been carefully constructed to exclude materials containing traces of radioactive materials and using a small ring of further counters in an anti-coincidence circuit to remove the effect of cosmic rays. In this way it was possible to gain a factor of about 10 times and achieve a background counting rate of only 1 count per minute.

Where the experimenter had the choice it was usually better to measure an α-activity rather than a β- or γ-activity if the highest sensitivity was the aim. This was because counters sensitive to α particles could be made to have a background counting rate of only 2 counts per hour. In these counters, the residual counting rate was due to small amounts of activity which occurred as impurity in the materials of construction, plus any activity in any air volume counted. It was not possible to use the anti-coincidence method to achieve further improvement in this case, since none of the residual counting rate was due to

cosmic radiation. However, the detectors usually employed for α-activity measurements (gas proportional counters and scintillation counters) were capable, in association with suitable pulse-amplitude analysers, of selecting events in any desired energy range. It was therefore possible to arrange the channel setting to embrace the energy peak of the required emissions and then only the background corresponding to this energy range would be counted. An improvement of at least 5 times was possible by this means.

A problem which had come to the fore in recent years was the measurement of the radioactivity of the human body. The efforts expended had been mainly directed towards measuring the natural radioactivity of the body and to devising techniques for the early detection of its increase. There were several reasons for this, but the chief one was the necessity of ascertaining at an early stage whether a person working with radioactive substances had been contaminated by them.

The extremely low value of the maximum permissible total body burden of many nucleides (1×10^{-7} curie for radium and 4×10^{-8} curie for plutonium) presented a measurement problem of real difficulty, especially as it was really necessary to make measurements below this level. Furthermore, it was also necessary to make measurements of subjects who had not been exposed to radioactive contaminants and whose body burden largely resulted from the natural potassium content. This involved measurement down to 1×10^{-8} curie or less.

Measurement of Fission Rate

Dr. Taylor then turned to radiation measurements relating to reactors and said that the fission rate and its rate of change in a reactor must be under control at all times from the shut-down sub-critical state to full-power operating level. When running at constant power a steady state was reached when the heat output was proportional to the fission rate. Under these conditions about 94 per cent of the power output came from the kinetic energy of the fission fragments and from radiations accompanying the fission process; the remaining 6 per cent was due to β- and γ-decay processes in the fission products which changed relatively slowly with power level. Heat output measurement could thus be used for the measurement of fission rates only over a small range near the maximum operating level. A more direct measurement of fission rate was necessary for control during shut-down and start-up, and neutron-flux measuring instruments were used for this purpose. The same type of instrument was also used at full-power operation, as it was possible to obtain a much shorter response time than was possible in calorimetric measurements, and thus guard against sudden transients in the fission rate or fission power.

If it was assumed that the neutron flux pattern throughout the reactor core remained constant, a measurement of neutron flux at a particular position in or near the core could be used as an indication of the fission rate. This method was employed on existing reactors. At high power levels the equipment could be calibrated in terms of power output against calorimetric measurements. Separate neutron-flux measurements throughout the whole of the core might also be used for calibration purposes. Two types of neutron-sensitive detectors were used in present reactor-control systems; (1) an ionisation chamber in association with a d.c. amplifier for use at the higher operating levels, and (2) a pulse counter in association with a counting-rate meter for use at low levels, particularly at initial start-up.

Abson and Wade had described an ionisation chamber for use over a wide range of neutron flux and discussed the limitations of a two-electrode chamber, using boron coating or BF_3 gas fillings, due to neutron-gamma sensitivity. The effective neutron-gamma sensitivity could be increased by using a "γ-compensated" device, which consisted of two chambers, one sensitive to $(n+\gamma)$ radiation and the other, connected in opposition, sensitive to γ-radiation only. In this ion chamber the electrical leads to the electrodes consist of concentric lines with quartz of alumina insulators, the collector electrode lead being evacuated to minimise unwanted currents due to γ-radiation. When used under water the rigid electrode lead system was extended to a region where normal gasket materials could be used to provide a water-tight seal round flexible polythene cables. The same technique might also be used where the temperature at the ion chamber was too high for polythene.

Boron 10 had been used almost exclusively in neutron-sensitive ionisation chambers, but at higher flux levels it would be necessary to adopt different methods, or boron depletion troubles would limit the chamber life seriously. One possibility would be to use lithium 6, and this would offer an advantage of about 4 times. There would, however, be a corresponding reduction in the neutron sensitivity with no change in the γ-sensitivity, and so the n/γ discrimination would be less than with the B10 system and this might not be acceptable. A fissile material probably offered the best solution to the burn-up problem. The fission cross-section and hence the depletion rate in a given flux was reduced by a factor of about 8 times over that possible with B10.

It was not unreasonable to have the main neutron detectors outside the reactor core and determine the neutron population by measuring the flux of escaping neutrons. If the fraction of neutrons escaping varied markedly with time or with power level then it might be necessary to install flux-distribution measuring equipment to provide periodic calibration data. This flux-measuring equipment was unlikely to be used as part of the control system directly; this was bound up with problems of reliability and inherent safety.

The methods of neutron detection used in the control instrumentation could also be used for flux-distribution measurements. The difficulties associated with radiation damage and high temperatures were accentuated in measurements in the reactor core. The difficulties could be avoided by using a neutron activation technique for the flux-distribution measurements. In this method a suitable material was introduced into the reactor core and irradiated for a specified time. It was then withdrawn and the induced β- or γ-activity (which was proportional to the neutron flux) was measured externally with an ionisation chamber or counter.

High Voltage Impulse Testing

THE striking of overhead electric power transmission lines by lightning can give rise to impulse voltages which demand high insulation properties in power transmission equipment. Impulse testing is therefore an important feature in the proving of high voltage equipment and a great deal of experience in the technique has been gained in the past twenty years. In a booklet entitled "High Voltage Impulse Testing" (H.M. Stationery Office, price 1s 6d) a description is given of experience gained in the High Voltage Laboratory of the National Physical Laboratory.

The publication describes the effects of lightning strokes on transmission systems, including the effects of strokes which strike not the conductors themselves but a tower, the overhead protective earth line or even the ground near the transmission line. In all these cases surges can be set up in the transmission lines. The production of test impulses in the laboratory, the creation of standard wave shapes and the making of test measurements are dealt with.

World Bank's First Decade

Finance for Electric Power Schemes

FROM A CORRESPONDENT

THE attendance of the British Chancellor of the Exchequer, Mr. Harold Macmillan, and the President of the Board of Trade, Mr. Peter Thorneycroft, at the recent annual general meeting of the World Bank in Washington serves to remind us that Great Britain is the second largest "shareholder" in the International Bank for Reconstruction and Development. As shareholders, however remotely, in this important institution, members of the electrical industry will note with satisfaction that approximately three-quarters of the total loans granted during the year ended 30th June, 1956, were for electric power development schemes in various parts of the world.

In all, the Bank made 26 loans in 20 countries, totalling the equivalent of some $396 million; "electrical" loans were made in eight countries, a list of which is given in the accompanying table.

Kariba Secures Largest Advance

The $80 million loan made to Rhodesia and Nyasaland is the Bank's largest advance for a single project. It will be in U.S. dollars, sterling and various European currencies and will help to finance the first stage of the Kariba hydro-electric scheme—namely, the building of a dam and a power plant with 500 MW of generating capacity and nearly 1,000 miles of transmission lines to the copper belt in Northern Rhodesia and the principal cities of Southern Rhodesia. The new installations will meet the increased demand for power expected from the continued expansion of copper mining operations and the exceptionally rapid growth of industry.

The loan was made to the Federal Power Board, a newly-formed Government corporation. The Board is responsible for the construction and operation of the Kariba project and will control the output of most of the existing thermal power stations when they become connected to the national grid.

The first stage of the Kariba development is expected to cost a total of about £80 million. The Bank's loan will finance £28·6 million of this amount; the Federal Power Board will finance the remainder through long-term borrowings in the United Kingdom and from the Government of the Federation. The Bank's loan is for 25 years and bears interest of 5 per cent including the statutory 1 per cent commission charged by the Bank. Amortisation will begin on 1st June, 1963. The loan is guaranteed by the Federation of Rhodesia and Nyasaland and the United Kingdom.

Two other loans deserve mention, those to Finland and Norway. The $15 million for Finland will help to finance three hydro-electric and two thermo-electric power plants and 235 miles of transmission lines which are to become a part of the country's integrated power system.

The loan will assist the Kemijoki Oy, a publicly-owned power company, in financing two new hydro-electric plants with a combined capacity of 220 MW on the Kemi River in Lapland. Both plants will be completed by 1960. Imatran Voima Oy, another publicly-owned power company, will use part of the loan to help complete a transmission line and related works which it is building to carry power produced at the Kemijoki plants to consumer centres in South Finland.

The third hydro-electric plant, of 22 MW capacity, to be built with the help of the Bank loan will be undertaken by Kaukas Ab, a privately-owned wood products company, on the Pielis River at Kaltimo in Eastern Finland. Kaukas Ab will sell power for distribution over the national grid.

The city of Helsinki and Pargas Kalkbergs are both constructing thermal power plants. Additional thermal capacity is needed for the national grid to ensure a regular supply of power in dry years and to supplement hydro-electric power in periods of peak demand. Both plants will be situated in areas of heavy industrial demand and near existing auxiliary facilities. The Helsinki plant will have a generating capacity of 75 MW and will go into operation by November, 1959. Pargas Kalkbergs is building its 27 MW plant on the island of Pargas, near the city of Turku in south-west Finland. It will be completed in the second half of 1958.

The total cost of these projects is estimated at the equivalent of about $103 million. The Bank's loan of $15 million will meet most of the foreign exchange requirements and will pay for imports of turbines, generators, switchgear, transformers and other equipment.

Norwegian Water-Power Development

The $25 million loan to Norway will help to finance the Tokke River hydro project which will add 400 MW of generating capacity to the electricity network serving south-eastern Norway, including Oslo. That area now consumes 55 per cent of all power produced in Norway. The first 100 MW unit will be put into operation in 1961 and the other three before the middle of 1963.

The Tokke project is the first stage in the complete hydro-electric development plan, which will involve regulation and utilisation of the Tokke and Vinje Rivers system and an ultimate installation of eight 100 MW generating units. The rivers will be linked by a tunnel. A transmission system including substations will also be constructed in the first stage and high-voltage lines will feed power from the new plant into the grid supplying south-eastern Norway. The grid is now supplied from a number of power plants with a total capacity of 1,800 MW. The project will be engineered, constructed and operated by the Norwegian Watercourse and Electricity Board. The total cost of the project is estimated at the equivalent of $70 million.

During the past year steps were taken to establish a

ELECTRICAL LOANS MADE DURING THE YEAR ENDED 30TH JUNE, 1956

Borrower and Guarantor	Date of Agreement	Amount $(U.S.)	Undisbursed Balance as at 30th June, 1956
Ecuador			
Empresa Electrica Quito S.A.	29.3.56	5,000,000	5,000,000
Finland			
Mortgage Bank of Finland ...	22.5.56	15,000,000	15,000,000
France			
Electricité et Gaz d'Algérie	16.8.55	10,000,000	3,580,000
Lebanon			
Litani River Authority ...	25.8.55	27,000,000	27,000,000
Nicaragua			
Instituto de Fomento ...	8.7.55	400,000	398,000
Norway			
Norwegian Watercourse & Electricity Board	3.5.56	25,000,000	25,000,000
United Kingdom			
Federal Power Board, Rhodesia & Nyasaland ...	21.6.56	80,000,000	80,000,000
Uruguay			
U.T.E.	29.8.55	5,000,000	3,759,000

new affiliate of the World Bank, the International Finance Corporation. Already thirty-two nations have joined. The main object of the I.F.C. is to further economic development by encouraging the growth of productive private enterprise in its member countries. It intends to do this by:—

(1) Investing in productive private enterprises, in association with private investors and without government guarantee of repayment, in cases where sufficient private capital is not available on reasonable terms;

(2) Serving as a clearing house to bring together investment opportunities, private capital (both foreign and domestic) and experienced management; and

(3) Helping to stimulate the productive investment of private capital, both domestic and foreign.

The funds of the I.F.C. are quite separate and distinct from those of the World Bank. Loans advanced by the World Bank must be guaranteed by the member-country in whose territory the loans are made. The I.F.C., however, makes loans for the expansion or improvement of productive private enterprise without government guarantees.

Overseas Representatives

USEFUL INTRODUCTORY TRAINING

IT is being increasingly realised that people going abroad as representatives of this country, whether on behalf of industrial or commercial undertakings or Government Departments, need some special preparation before their departure. Particularly in countries with growing self-consciousness, such as those in South and East Asia, the Middle East, tropical Africa, Latin America and the Caribbean, business representatives are meeting situations for which their highly specialised training, set within the peculiarly insulated social framework of this country, has left them largely unprepared.

In response to the demand for training for responsible representation abroad, Oversea Service, an entirely new venture, began early in 1954 its first series of introductory training courses. This aroused great interest and support and the courses are now firmly established. The most recent was a six-day residential course at the Imperial Institute, South Kensington, and at Moor Park College, near Farnham, Surrey, devoted to South-East Asia.

Having spent four months covering a vast mileage in the Far East on behalf of his company, Mr. Nigel W. Waite (W. T. Glover & Co., Ltd.) was asked to attend the course and we are indebted to him for these notes. Mr. Waite says that the intention was primarily to test the value of such a course to members of his company going abroad for the first time, but it also enabled him to see things in their proper perspective, which is often so difficult to do on one's first visit to entirely new countries abroad.

At the Imperial Institute those attending the course were briefed in the objects, organisation and support activities and achievements to date of Oversea Service by Dr. H. B. T. Holland, the general secretary. During the course of a day spent in seeing films of Malaya, Sarawak, Hong Kong, etc., a conducted tour was made of the galleries of the Institute where life and customs in South-East Asia are depicted in excellent dioramas.

The title of the series of lectures and discussions at Moor Park College was "Wider Horizons: An Introduction to Living Abroad" and the subject was pursued under the headings of world forces—economic, cultural and ideological; the British heritage—asking the question of what we represented abroad; race and nationalism; and personal relationships. There were twenty students, men and women, and wives and children were included.

Emphasis was on real-life questions which demand a responsible answer and not on academic studies. All discussion was "off the record," no subject being barred. There were no confidential reports or examinations, the prospect of which often takes much of the enjoyment out of such a course. Factual information, through visual aids, books, and pamphlets was available in plenty and there was ample time for informal discussion and conversation.

The special features of these courses, which are organised for all territories in the world, are the wealth of speakers and guests, who have either some special knowledge of history, administration, industry, race relations, or first-hand experience of the territory being studied. Business, government, the professions and the church are all represented by women as well as men. Nationals of the countries studied were specially invited. Among the eminent speakers were Sir Vincent del Tufe, K.B.E., C.M.G., formerly Chief Secretary in the Government of Malaya and now delegate-designate for the Federation of Malaya International Tin Council, Professor Vincent Marlow, C.M.G., Beit Professor of the History of the British Empire and Fellow of Balliol College, Oxford, and Sir Richard Windstedt, K.B.E., formerly of the Malayan Civil Service, and now at the School of Oriental and African Studies.

Mr. Waite says that he felt strongly that had he been armed with the knowledge which such a course can give, before setting off on his recent Far Eastern tour, it would have equipped him to be a better ambassador for this country and his company. In these days it is essential that members of companies visiting foreign territories should have, at least, a working knowledge of the traditions, customs and political background of these countries. This would enable them to adopt the calm, unemotional, rational approach to problems which must be displayed by representatives of a democratic country which, technically and politically, is far in advance of many of those countries with whom we trade abroad. Mr. Waite concludes:—

"Dependent for our very life, as we are in the United Kingdom, on healthy overseas trade and recognising the increasingly fierce competition for goods and services with which we are faced, we are, nevertheless, almost hardened against the constant advice to improve the quality of our key 'export,' namely, those company representatives who are sent abroad. Undoubtedly, they are selected as carefully as possible in present conditions and trained to a high standard—but in a world whose attitude to the Western nations has undergone a revolutionary change in the last fifteen years, can we be satisfied with dispatching personnel overseas without at least a basic grounding in the conditions and practices they are liable to encounter abroad? It is in answer to this question, that in my view, Oversea Service is making a very valuable and practical contribution."

VIEWS on the NEWS

By REFLECTOR

A COUPLE of weeks ago I commented on an advertisement in which an American electronic firm offered a number of inducements to British engineers and scientists for positions on its research and development staff. Now I have seen an announcement in the *Economist* by the New York State Commissioner of Commerce which is designed to attract British manufacturers to his State. The Commissioner deals principally with New York's water supply for industrial purposes and offers reports on this subject and "complete facts on labor, markets, available sites or buildings, power, fuel, transportation and raw materials." If British engineers and scientists go to the United States it is probably better for this country that they go as part of a British organisation setting up business there.

* * *

While work on the Central Electricity Authority's Ffestiniog hydro-electric scheme is temporarily suspended for financial reasons some smaller water-power schemes in North Wales are helping to fill the gap to a very small extent. Some of them are mentioned by John Eilian in the *Western Mail*. One, at Yspyty Ifan, was started by the local smith and supplies electricity to the parish at "a crown a lamp." Mr. Lloyd, the smith, says that he thought that if life were made easier and brighter the people would stay in the village so he made it easier and brighter. At New Mills, near Welshpool, Mr. H. V. Bowen generates enough power from a stream running through his garden to drive a number of workshop appliances and supply four cottages as well as to charge the villagers' batteries. Moreover, a quarter of a mile away Mr. Bowen has a mill where a stream has been harnessed by means of a weir and a 12ft waterwheel which drives a small generator. The latter supplies electricity to Mr. Bowen's machines. It is stated that the cast-iron waterwheel has sheet-iron blades which were made 106 years ago.

* * *

Continuing the discussion on his hot-water installation, Mr. F. Rostron first absolves me from the blame attached to me by Mr. L. C. Parker. He then says that Mr. Parker is right in stating that a mathematically exact comparison of the electrical and gas methods of firing his central heating cum water heating boiler should include the efficiency of heat transfer of each installation. He maintains, however, that electricity costs him exactly 60 per cent more per therm than gas and he thinks that such a cost difference completely swamps any possible difference in efficiency. He has not been able to trace the makers of the boiler to obtain efficiency figures from them. Undoubtedly, for the single-room heating appliances, the comparative efficiency is a very important factor because gas is then supplied at the normal domestic rate and not at his advantageous industrial price. Mr. Rostron says he would not entertain the use of individual gas room heaters; all his "topping-up" is done by electric fires. After referring to the advantage of his boiler in keeping the scullery at a comfortable working temperature, Mr. Rostron reverts to his main point that as there is a specially reduced rate available for domestic bulk consumers of gas, why should there not be a similar concession for domestic bulk consumers of electricity?

* * *

A *Manchester Guardian* correspondent tells of a deception practised on Queen Victoria when she opened the new town hall in Sheffield in 1897. The ceremony of opening the gates was to be performed by remote control as the Queen was unable, on account of infirmity, to leave her carriage. A lock was carried to her and it was connected by wires to the gates, the work being carried out by a local firm of electricians. When Her Majesty inserted a golden key into this lock the gates immediately swung back. It is now revealed by an 81-year-old employee of the electricians that in actual fact there was a last-minute hitch in the electrical arrangements and when the Queen turned the key all it did was to actuate a buzzer: whereupon two men concealed behind curtains at the gates pulled on ropes to open the gates when they received the signal.

* * *

I believe I have mentioned on previous occasions the beautifully produced *Révue des Applications de l'Electricité* (formerly *B.I.P.*) a magazine published by the French equivalent of our Electrical Development Association. The opening article of the current issue deals with the lighting of cinema studios and I note that the author is M. Jean Vivié, Ingenieur Civil des Mines, Professeur à l'Ecole de Photographie et de Cinéma. Out of darkness into light!

* * *

An American Department of Commerce report on electrical export trade was quoted in the *Electrical Review* of 12th October, 1906. This made much play of the pre-eminence of the United States in this field and rejoiced in the fact that the United Kingdom was their third best customer. The *Review* commented on the report as follows:—

> "If British manufacturers have mastered the art of producing electrical machinery, they have certainly failed to a great extent in mastering the art of putting their products on to the world's markets as successfully as the Americans. . . . American manufacturers have grasped the fact that there is a tremendous future before the electrical industry. . . . In the case of the several South and Central American States the success of the United States may have been due to proximity of position; but the fact that German manufacturers have succeeded in gaining a great trade in these States is proof that this proximity of position is not the only factor in securing the trade. Both Germans and Americans have discovered the truth of the statement that trade follows investment of capital."

Figures were given of electrical machinery exports in 1904-05 showing that the United States total was £1,518,944 and that of the United Kingdom £644,480.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Private Generating Plant

I HAVE just read the interesting article on this subject by A. J. Ellison in your issue of 17th August. I was particularly interested in it because recently I have been consulted about the installation of a hydro-electric plant intended to drive a small old-established factory in the north east of Scotland.

The machinery is still driven by a breast waterwheel with a fall of 7ft on a run-of-river supply, and developing, it is said, about 35-40 h.p. The power from the wheel is supplemented in an unusual manner. A d.c. generator driven from the shafting charges a large capacity storage battery, which, with a reduction in wheel speed, returns current to the generator, and the latter, acting as a motor, contributes power. It will be seen that this ingenious but simple arrangement also assumes the functions of a governor. The system has performed perfectly since the early years of the century, the only expense incurred being the occasional renewal of battery plates.

Before the war the cost of battery plates was not an unduly heavy item, but the proprietors are now faced with replacing the negative plates and they find an enormous increase in prices. So much so that, as an alternative, they have been impelled to inquire regarding connection to the Hydro Board's grid; but there, also, the quotation they received was far from encouraging especially as it imposed a prohibition on the use of their water power. This they particularly resented, as it had served them well for over a century. In order to overcome this difficulty it was suggested that a turbine-driven induction generator should be installed which, with the consent of the Board, would return a constant contribution to the grid.

Your article, however, paints a rather discouraging picture of such an installation, of which, apparently, the very large exciting current required from the line is a feature. If it is the case that, at full load, 40-50 per cent of the output is required for excitation, then it seems astonishing that the North of Scotland Hydro Board has constructed stations on this principle. (I exclude compensation water sets.) The large cost of the civil engineering compared with the small saving effected by the installation of asynchronous generating plant would seem to indicate false economy if what your contributor says is correct. I have no reason to doubt his statement, but some of your readers may care to comment.

They may also like to make suggestions as to the best and most economical method of overcoming the difficulties which I have outlined. In view of the great shortage of coal it seems a great pity not to make use of all the available water resources we have, however small. Incidentally, there is a small diesel engine already installed at the factory (it was used at times of very low water) which could be turned to advantage in any new scheme which might be proposed.

Rosehall, near Keith, Banffshire. S. G. LAIDLAW.

Architects and Lighting Engineers

I READ with interest Mr. Young's article on this subject (*Electrical Review*, 21st September) and would suggest that the " three reasons " attributed to the architects are very sound; but in my experience, architects are looking more to consulting engineers to guide them on the more technical aspects of lighting.

In these times, a good lighting scheme should also be an economical one and the consulting engineer is the one to give advice to the architect in order to ensure that the client is getting value for money invested. Therefore, Mr. Young would be well advised to advocate a three-fold co-operation if the lighting engineer is to play an active part in lighting schemes.

Liverpool. OSCAR C. WAYGOOD, *Consulting Engineer.*

Manchester Association of Engineers' Centenary

THIS week the Manchester Association of Engineers celebrates its centenary. Events have included a thanksgiving service in Manchester Cathedral, a civic reception by the Lord Mayor of Manchester and a banquet and ball at the Midland Hotel. This year's president is Mr. G. R. Adamson, who on Monday gave his inaugural address, " On Boiling Water."

The Association, which has 700 members—electrical, civil and mechanical engineers, practising in Britain and overseas—developed from a regular Saturday evening meeting of foremen and their friends at the Merchant Hotel, Oldham Street, Manchester, to discuss the problems and experiences in local engineering works. The first entry in the Association's records is dated 14th January, 1856. These " unofficial " meetings paved the way to the formation of the " Association of Employers, Foremen and Draughtsmen of the Mechanical Trades of Great Britain." That omnibus title was replaced in 1885 by the present austerely dignified one. Meetings have been held at regular intervals without a break for 100 years, first at various hotels, then in the Mechanics' Institute and Memorial Hall, and since 1924 in the Engineers' Club, Albert Square. Meetings are held fortnightly from October to March for the discussion of subjects of interest to the general body of engineers, particularly new developments. The centenary year programme includes the following papers: " Design and Development of the Deltic Engine," by C. D. Carmichael, 9th November; " Computers in Industry," by B. Pollard, 23rd November; " Post-war Trend of Power Station Plant Design," by F. J. Hutchinson, 8th February; " Industrial Television," by J. E. H. Brace, 15th March; and " Nuclear Engineering," by J. Diamond, 29th March. Professor H. Wright-Baker, of Manchester University, an ex-president, is to give a paper this week on " The History and Future Development of Education for Engineering."

Balanced Load Development

Increased Diversity from New Electrical Applications

METHODS of making the maximum use of capital plant by means of selective load building provided the subject of the inaugural address delivered on 11th October by Mr. H. J. Gibson (Midlands Electricity Board) as chairman of the Utilisation Section of the Institution of Electrical Engineers. By a series of load curves for main groups of consumers (industrial, domestic and commercial) he indicated their increasingly complementary character resulting from the substantial diversity between them due to the use of electricity for an ever-growing variety of purposes. Within each group there was also a wide diversity and many applications having individually low load factors could be as important as those with high load factors.

Tariffs that offered inducements to load factor improvement were usually not enough of themselves, their significance not being always understood by consumers, who would need guidance. Commercial engineers of the Area Boards must have an extensive knowledge not only of established applications of electricity but also of its possibilities as a substitute for or in adaptation of other methods.

Staggered Operating Cycle

An example of economic co-operation with a consumer to improve load factor was provided by the staggering of the working cycle (without affecting production) of two or more electric arc furnaces, which tended to supersede the open-hearth process in the production of lower-grade steels. The load factor of an individual furnace was about 35 per cent, but the demand during melting was much higher than during soaking. The resultant demand could therefore be reduced in winter at prescribed times justifying the quotation of a special tariff with low demand component.

An uncommon use of public electricity supply was the energising of the cyclotron and synchrotron at Birmingham University. Power to excite the magnet of the synchrotron was obtained from two d.c. 500 r.p.m. generators operating in parallel and driven by a 1,500 h.p. 11 kV three-phase induction motor. A 36-ton flywheel coupled to the machines minimised the effect on the supply mains of the rise to peak load (about 8 MW) in one second in every ten. The power factor was improved from 0·6 to 0·95 by 370 kVAr of capacitors at the 11 kV input, the cost of which was repaid within two years by saving in electricity charges; in addition internal-cable capacity was substantially increased.

Pottery Kilns

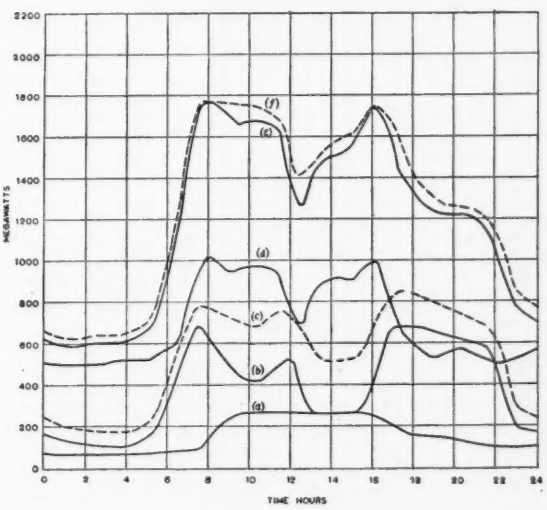
A new type of electrically fired horizontal intermittent pottery kiln, designed seven years ago by the Midlands Electricity Board in co-operation with leading potters, had many advantages over continuous kilns for certain products. For higher temperature processes (up to 1,300 deg C) heat-retaining bricks had formerly contributed to element failure, but this trouble was cured by the substitution of high-grade heat insulating fire bricks having low heat-storage capacity and the use of 90 V elements automatically temperature-controlled. Operating cycles for pairs of kilns could be arranged to give a 90 per cent load factor at which the running cost of electricity supply averaged 55 per cent of the coal cost for older types of kilns and repairs and maintenance were in similar proportion. Vertical electric kilns, also working in pairs, had been developed in which the ware was not subjected to vibration or draughts.

An electrical method of drying gypsum plaster moulds for the manufacture of pressure-cast match plates, in which current-carrying metal tape was cast into the plaster, had been proved to save a substantial amount of time compared with the 60 hours required in an orthodox recirculating air stove.

Rural Industries

To make the most use of capital expended on mains and substations in rural districts during the development of the large potential uses of electricity on farms and in country houses, every encouragement was given to industries with local associations. A typical example was cited of a factory producing fruit extracts (chiefly blackcurrant) which had a refrigerated storage capacity of 300,000 gal, believed to be the largest in the country. The processing of the blackcurrants, which were harvested within five weeks, could thus be spread over the whole year, giving an average monthly maximum demand of about 280 kVA and a yearly consumption of over a million kWh supplied at an average price of 1·135d.

An instance of floor warming by night, using buried resistance cables, was given in regard to a single-storey factory with a floor area of 25,000 sq ft. Because of the high air temperature specified in this case a few supplementary self-contained thermal-storage heaters were also installed, giving a total capacity of 400 kW. Experiments being conducted on floor warming in glasshouses and on soil warming by night showed promise of successful results.



System and group load curves: (a) *Commercial.* (b) *Domestic.* (c) *Commercial and domestic.* (d) *Industrial.* (e) *Total daily demand curve.* (f) *Total period maximum-demand curve*

PERSONAL AND SOCIAL

News of Men and Women of the Industry

The National Executive Committee of the Electrical Association for Women announces the appointment of **Miss Mary George,** M.B.E., B.A., principal information officer, Ministry of Agriculture, Fisheries and Food, as director and secretary of the Association. In this post she succeeds **Dame Caroline Haslett,** and will be taking up her office next month. Miss George, who is a graduate in English of London University, has been responsible for directing the following four branches of the Ministry's work: publications; special publicity concerned with national food campaigns and with the work of the United Nations Food and Agriculture Organisation; overseas visitors; and libraries. She has represented her Department for a number of years on the National Executive of the National Federation of Women's Institutes and has also worked closely with other women's organisations.

Miss Mary George

At a meeting of the Society of Instrument Technology recently Mr. G. A. Whipple, M.A., M.I.E.E., president of the Scientific Instrument Manufacturers' Association of Great Britain, presented the Bowen Prize to **Mr. N. Ream** for his paper on "Calculation of Process Control Setting from Frequency Characteristics," and to **Mr. T. Land** and **Mr. R. Barber** for their paper on "The Design of Section Pyrometers." This was followed by a presentation, subscribed for by past and present members of the Council of the Society of Instrument Technology, to **Dr. H. Moore,** C.B.E., on the occasion of his retirement from the hon. editorship of the Society's *Transactions.* This presentation was made by Mr. A. J. Young, B.A., B.Sc., president of the Society.

The British Transport Commission announces that following the retirement of **Mr. F. B. Illston,** carriage and wagon engineer, on 30th June and **Mr. H. H. Swift,** chief mechanical and electrical engineer, on 21st July, it has been decided to amalgamate these two departments into one department of the Southern Region, and as from 1st October **Mr. W. J. A. Sykes** has been appointed chief mechanical and electrical engineer in charge of the combined department. The considerations which have given rise to this change are that within the next few years there will be a gradual reduction in the use of steam locomotives and an increase in electric and diesel traction with extended use of multiple-unit stock.

Mr. T. C. Johnston and **Mr. B. E. Mallock,** M.A., F.C.I.S., have been appointed directors of the Metropolitan Electric Cable & Construction Co., Ltd. Mr. Johnston has been sales manager since 1939 and Mr. B. E. Mallock secretary since 1938.

The B.B.C. is presenting one or two research scholarships each year, valued at £385 per annum, to university graduates in electrical engineering or physics who obtain good honours degrees, giving them the opportunity to work for a higher degree at any university in the United Kingdom. The scholarships are for two years in the first instance with the possibility of extension in suitable cases, if necessary. The only condition applying to the subject for research is that it must be in those fields of telecommunications or physics which have an application to sound or television broadcasting. The Corporation has given one research scholarship only this year, to **Mr. P. C. J. Hill,** who graduated at Birmingham University with 1st class honours in electrical engineering. Mr. Hill will conduct his researches in the Department of Electrical Engineering at the Imperial College of Science and Technology.

At the first meeting of the Illuminating Engineering Society of the 1956-57 session which took place at the Royal Institution on Tuesday, **Mr. W. E. Harper,** B.Sc. (Eng.), Ph.D., M.I.E.E., F.I.E.S., took office as president. Dr. Harper was educated at King Edward VI School, Stourbridge, and at Birmingham University. From 1938 to 1946 he was with the Illuminating Department of the Research Laboratories of the General Electric Co., Ltd., and since 1946 he has been with the Plastics Division of Imperial Chemical Industries, Ltd., where he is responsible for work dealing with the application of plastic materials to lighting equipment. He has twice been awarded the Leon Gaster Memorial Premium for papers presented to the Society.

Dr. W. E. Harper

The I.E.S. Council announces that the Leon Gaster Memorial Premium for 1956 has been awarded to **Mr. D. W. Durrant** for his paper entitled "Decorative Lighting—A Designer's Approach" which was presented at the Society's Summer Meeting held at Harrogate in May.

Major-General C. A. L. Dunphie, C.B., C.B.E., D.S.O., a director of Vickers, Ltd., has now been appointed managing director of the company with effect from 1st October.

Mr. G. A. Marriott, B.A.(Cantab.), who has been nominated as president of the British Institution of Radio Engineers for 1956-57, is manager of the Osram Valve and Electronics Department of the General Electric Co., Ltd., and a director of the Marconi - Osram Valve Co., Ltd. He joined the G.E.C. on graduation in mechanical sciences at Cambridge University and has remained with the company throughout his professional life. From 1914 to 1918 he served in the King's Royal Rifle Corps.

Mr. G. A. Marriott

Mr. Marriott has served on the board of the British Radio Valve Manufacturers' Association since 1940, and has been vice-chairman and chairman of the Association for several years. He has also been chairman of the Radio Industry Council, and is still a member of the Executive Committee. He was elected a vice-president of the Brit.I.R.E. in 1954.

Professor Emrys Williams, Ph.D., B.Eng., of the Department of Electrical Engineering, University College of South Wales and Monmouthshire, Cardiff, has been nominated as a vice-president of the Institution and the following as new members of the Council:—**Mr. A. D. Booth,** D.Sc., Ph.D., director of the Birkbeck College Computational Laboratory and University Reader in Computational Methods at the University of London; **Mr. E. M. Eldred,** of the Communications Branch of the Home Office; and **Mr. R. H. Garner,** B.Sc.(Eng.), principal of Coatbridge Technical College, Lanarkshire.

The importance of good relations in industry was stressed by the Lord Mayor of Leicester (Alderman A.

Halkyard) speaking at the annual dinner-dance on 5th October at the Grand Hotel of the Leicester Branch of the **Electrical Contractors' Association.** Commenting on the part played by the Association in maintaining good relations with all sides of the industry, Alderman Halkyard remarked that the relations between the contractors and the Electricity Authority remained as excellent as in the past and that relationship and harmony was vital not only to their industry but to the country as a whole.

Mr. H. S. Wathes, vice-president of the Association, said that one of the most important functions of the Association had always been to ensure that its members were properly qualified to carry out their professional duties. The Association was taking an active part in the National Inspection Council.

Mr. H. E. Vickers, A.M.I.Mech.E., M.I.E.E., generation engineer (operation), Yorkshire Division of the Central Electricity Authority, has been appointed chief generation engineer (operation) of the South Western Division. Mr. Vickers completed his training as a works apprentice and trainee with the Yorkshire Electric Power Co. in 1924 and subsequently held various station appointments at Newcastle-upon-Tyne, Worcester, Hull and Fulham. In 1946 he was appointed generation engineer of the Hull Electricity Department and took up his present position with the Yorkshire Division of the Authority in 1948.

Mr. P. V. Gurr, J.P., Folkestone district manager of the South Eastern Electricity Board, has been appointed a member of the East Kent and Canterbury Local Valuation Panel, dealing with rating appeals following the recent reassessment.

Mr. S. C. Irving, A.M.I.E.E., M.Inst.F., tells us that he is sailing for Canada this week to take a position with the Manitoba Hydro-Electric Board in connection with its change-over to steam generation, and that his first duties will be to commission the new 120 MW station at Brandon. Before joining the Manitoba Board Mr. Irving was chief engineer of Ferguson Bros., Ltd., of Carlisle, having previously seen service with the Southport, Bradford, Croydon and Hounslow electricity undertakings, the City of London Electric Lighting Co. and the Northampton Electric Light & Power Co. before going to Poole as deputy station superintendent.

British Insulated Callender's Cables, Ltd., announces the appointment of **Mr. K. Collinson,** A.M.I.E.E., as branch manager, Leeds, in succession to the late Mr. J. R. Tommis.

Mr. K. Collinson

Mr. Collinson, who was educated at Salts School, Saltaire, and the Bradford Technical College, served with Collinson Bros., the electrical and mechanical engineers, Bradford, before joining the former Callender's Cable & Construction Co., Ltd., in 1938. During the years 1940-46 he served in the Royal Navy as an electrical officer, R.N.V.R., and on his release he rejoined Callender's, which had then amalgamated with British Insulated Cables, Ltd. In 1951 he was appointed to the B.I.C.C. Leeds branch as a sales engineer.

Mr. E. L. Wildy, managing director of the London Electric Wire Co. & Smiths, Ltd., has been appointed deputy chairman of the company. He was recently appointed chairman of its subsidiary, the Liverpool Electric Cable Co., Ltd., on the resignation of **Mr. A. Noel Smith,** who retired from the chairmanship but retained his seat on the board. **Mr. S. B. Klein,** a director, has been appointed assistant managing director of the parent company.

General Sir William D. Morgan, G.C.B., D.S.O., M.C., chairman of Siemens Brothers & Co., Ltd., has been appointed chairman of Submarine Cables, Ltd., for three years commencing 1st October. Submarine Cables, Ltd., is owned jointly by Siemens Brothers & Co., Ltd., and the Telegraph Construction & Maintenance Co., Ltd., and its chairman is nominated by the two parent companies in rotation. **Mr. J. N. Dean,** the retiring chairman, retains the office of managing director which he holds jointly with **Mr. F. S. H. Lemon,** O.B.E.

Mr. Frederick W. Martin has been appointed to the board of Tube Investments, Ltd. Mr. Martin is the deputy chairman of a number of the group's subsidiary companies in its Electrical and Steel Tube Divisions and has served T.I. since its formation in 1919. He played a major part in the establishment in this country of the electric resistance welded tube industry.

Mr. J. W. Ridley, B.Sc.(Econ.), has been appointed sales manager to British Physical Laboratories, Ltd., Radlett, and the Quadrant Meter Co., Ltd. Mr. Ridley joined British Physical Laboratories at the beginning of this year, and was previously with Magnetic & Electrical Alloys, Ltd.

Mr. J. T. Cooper has been appointed sales engineer at the Leicester office of Brook Motors, Ltd. Mr. Cooper has twelve years' service with the company and is a former apprentice. He received his training at the Dewsbury Technical College and served in the R.A.F. as an electrical mechanic. Before taking up this appointment Mr. Cooper had been in the Load Testing Department at Huddersfield.

Mr. J. T. Cooper

The annual ball of the **Association of Electrical Machinery Trades** will be held on 16th November at the Savoy Hotel, London, W.C.2.

Mr. W. E. Young has expressed his desire to retire from Yarrow & Co., Ltd., after being with the company for 46 years, and is resigning from the board of the parent company and also from the board of Yarrow (Africa) (Pty.), Ltd., on 31st December next.

Mr. R. Woodhead, chief electrical designer with Wright Electric Motors (Halifax), Ltd., is retiring on 31st October after fifty-two years' service with the company.

Sir John Maud, Permanent Secretary to the Ministry of Fuel and Power, was the principal guest at last Tuesday's luncheon of the **Electrical Industries Club.** He was introduced by the president, Mr. Leslie Gamage, who announced that at the next luncheon (13th November) the speaker would be Mr. A. L. G. Lindley (Fraser & Chalmers) who would talk on

Cheques were recently presented to three employees of W. T. Glover & Co., Ltd., in recognition of their long service. In the photograph Mr. J. H. Maxwell, director and deputy general manager (left), who made the presentations, is seen with the recipients, Miss M. Foden, Miss E. Gordon and Mr. J. Cardwell

nuclear power. Sir John Maud gave a stimulating address and a vote of thanks was called for by Mr. H. Senior Fothergill.

Mr. W. Price, previously with Brookhirst Switchgear, Ltd., and for many years with Allen West & Co., Ltd., has been appointed general manager of the electric control gear department and works of William Geipel, Ltd.

OBITUARY

Mr. A. D. Markland.—The death occurred on 5th October of Mr. Alfred Dumello Markland who, until he retired in 1946, had been associated with B.T.H. turbine plant since the company commenced manufacture in 1903. Mr. Markland was born in 1895 and received his technical training in mechanical and electrical engineering at the Technical College, Manchester, where he obtained an honours certificate in electrical technology. He spent three years at the works of the General Electric Co., Ltd., Salford, and subsequently held various appointments with the Corporations of Bolton, Ashton-under-Lyne and Glasgow. In 1902 he joined the staff of the B.T.H. Co. in what was then the Power and Lighting Department—the forerunner of the present Turbine Contracts Department, of which he was assistant manager for over twenty years.

The late Mr. A. D. Markland

Mr. Markland leaves a widow, two sons and a daughter. Both sons were at one time with the B.T.H. Co. as apprentices and one of them, Mr. John D. Markland, is home sales manager of the Hotpoint Electric Appliance Co., Ltd.

Mr. J. V. Franklin, managing director of Black & Decker, Ltd., died in hospital on 7th October at the age of fifty-six. He joined Black & Decker in 1927, two years after the British company was established, and was appointed to a position in the Sales Department. In 1937 he was appointed acting managing director on the death of the managing director, the late Col. W. V. Franklin, D.S.O., and in the following year he became joint managing director. Shortly after this the factory moved from Slough to its present site at Harmondsworth and in 1947 Mr. Franklin was appointed managing director.

Mr. L. H. Combe.—The death is announced of Mr. Leonard Harvey Combe, M.I.E.E., of Broadbridge Heath, near Horsham, Sussex, which occurred on 7th October.

Atomic Energy Patent Action

ON 2nd October an application was made to Mr. Justice Lloyd-Jacob in the Chancery Division of the High Court on behalf of Philips Electrical, Ltd., to fix a day for the hearing of a petition for the extension of an atomic energy patent. His Lordship adjourned the application, with liberty to restore upon four days' notice.

The patent in question is for "Methods for increasing the efficiency of nuclear reaction and products thereof." It was granted in 1934 to G. M. Giannini & Co., Ltd., New York, and Philips Electrical, Ltd., are the present proprietors. There is an action now pending in the Chancery Division, brought by the proprietors against the United Kingdom Atomic Energy Authority on the grounds of infringement, and the purpose of the present application was to endeavour to obtain adjournment of the hearing of the petition until after the hearing of the action. The reason for this was that the ground of the petition is inadequate remuneration, and until it is established whether or not the proprietors are entitled to damages from the Authority it cannot be known whether they have been adequately remunerated.

Mr. J. P. Graham, Q.C., who appeared for the petitioners, said that no remuneration had so far been received in this country because the only way in which this patent could be exploited was by licence to the Authority. No such licence had been taken out and that was the reason for the action for infringement. Certain issues were common to both the petition and the action and, as the result of the action could materially affect the grounds of the petition, the petitioners were asking for adjournment until after the action had been decided. The application was supported by Mr. Guy Aldous, Q.C., for the Authority. He said that it would be unreasonable to decide upon the petition before the action. If the action showed that there was no merit in the invention, the application for extension would be bound to fail.

Mr. G. W. Tookey, Q.C., opposing the application on behalf of the English Electric Co., Ltd., and the General Electric Co., Ltd., argued that an application for extension was bound to create uncertainty, and to adjourn the hearing of the petition until after the action would mean that his clients would not know their position. Mr. Stanley Levy, for the A.E.I. John Thompson Nuclear Energy Co., Ltd., supported this argument by saying that his clients, who designed, built and sold nuclear reactors, had two firm orders and two fairly imminent orders for this equipment, and it was important for them to know where they stood.

His Lordship, in giving judgment, said he considered that it was in the public interest that the hearing of the petition should take place after the hearing of the action. He also had to take into account the fact that certain evidence, necessary to the petition but not to the action, might involve matters of security.

Golf Championship at Bristol

THE Electrical Industries National Golf Championship was held on 1st October at Bristol for the first time.

At the Long Ashton Golf Course the national final was played in the morning and, despite the wretched weather conditions, was won with an extremely good score by Mr. H. Dupin of the General Electric Co., Ltd., London. His figures were 76 less 11 handicap=65 net. The runner-up was Mr. R. D. Green of Green & Smith, Ltd., Leeds, with a score of 78 less 11 handicap=67 net. The J. Y. Fletcher Cup for the best scratch score was won by Mr. K. A. Cameron, St. Ives, with 74.

On the same course in the afternoon, the players competed for the foursomes cups presented by the late Sir Felix Pole. The winners were Mr. R. D. Green, of Leeds, and Mr. H. Harding, of Helsby, Warrington, the runners-up being Mr. H. Dupin and Mr. C. E. Furness of the G.E.C., London.

At the Bristol and Clifton Golf Course, Failand, some 70 people competed during the day for the Visitors' Trophy presented by the Electrical Wholesalers' Federation, and the Veterans' Trophy presented by the *Electrical Journal*. The former was won by Mr. R. Betley, of London, with a score of 82 less 14 handicap=68 net; the runner-up was Mr. J. A. Willbourne, of London, with a score of 93 less 24 handicap=69 net. The Veterans' Trophy was won by Mr. G. F. Sills, of the English Electric Co., with a score of 35⅜ points.

In the evening a dinner was held at the Berkeley Restaurant, Bristol, where the chair was taken by Sir Henry Self. The toast of "The Golf Championship and the Electrical Industries Benevolent Association" was proposed by Mr. E. M. Hughes, the present chairman of the E.I.B.A. South-Western Area Committee. Sir Henry Self responded and presented the prizes. He announced that the anticipated sum raised this year would be the record figure of £3,600. During the evening Mr. Sydney Burchall entertained the guests.

All the arrangements for the dinner were made by Mr. Alan Hughes, of British Insulated Callender's Cables, Ltd., Bristol, who is the local area secretary for the Golf Championship. The arrangements for the whole meeting were made by the hon. secretary, Mr. Frank Farthing, of the G.E.C.

INDUSTRIAL NEWS

Plant for Fast Breeder-Reactor

The United Kingdom Atomic Energy Authority has placed a contract with the General Electric Co., Ltd., for a 15 MW steam turbo-alternator to be installed in Britain's first fast breeder-reactor nuclear power station now under construction at Dounreay, Scotland. It will operate initially under steam conditions of 150 lb/sq in and 518 deg F. The alternator will generate at 11 kV and will be a three-phase, 50 c/s machine.

The turbine for this plant will be built at the Fraser & Chalmers Engineering Works at Erith, Kent. This works is also the research and design centre of the G.E.C.-Simon Carves Atomic Energy Group, formed in 1954 to design and construct complete nuclear power stations. The Motherwell Bridge & Engineering Co., which will fabricate pressure vessels for nuclear power stations in association with this group, is already concerned in the construction at Dounreay where it is building the sphere which will contain the breeder-reactor.

E.D.A. Public Speaking Competition

The subjects chosen for next year's E.D.A. Public Speaking Competition have just been announced. Following last year's innovation, a "free" subject has again been offered to competitors in addition to the two set themes, which will be "Automation and the Housewife" and "The Importance of Clean Air."

The rules of the competition remain the same as in previous years. Members of the staffs of the electricity supply industry (including the generation divisions), who have not attained their 35th birthday on 31st March, 1957, are eligible to take part excepting those who have been first place winners in previous national competitions or have competed in two previous national finals. As usual area competitions will be held, the winners going forward to the national final, held in London, where the Faraday silver challenge shields are presented to the winners. In each area contest £10 is awarded to the winner and £5 to the runner-up. The closing date for entries is 1st December next. A booklet, "Public Speaking is Great Fun," aimed at interesting potential participants in the competition, is available, free of charge, from E.D.A., 2, Savoy Hill, London, W.C.2. This book gives details of the rules, the subjects, some brief hints to competitors, and competition entry forms.

South African Tariff Application

Among recent Customs tariff representations to the South African Board of Trade and Industries is one for bringing into operation the suspended duty on electric lampholders, switches, plugs, adaptors, switch units and other installation material. The British Board of Trade is informing the trade organisations thought to be interested and members of such organisations desiring to make representations to the South African authorities should get into touch with their organisations in the first place. Firms wishing to make independent representation or requiring further information should communicate with the Commercial Relations and Export Department, Board of Trade, Horse Guards Avenue, London, S.W.1, quoting reference C.R.E. 235/55.

Safety Equipment Exhibition

The first Protective Clothing and Safety Equipment Exhibition will be held at the Empire Hall, Olympia, from 13th to 17th May next.

Walsall Conduits Derby Branch

A new sales branch of Walsall Conduits, Ltd., was opened on 1st October at 26, Whitecross Street, Derby. This was preceded by a reception on 29th September and the official opening of the depot was performed by Mrs. L. H. Butler, wife of the managing director. This sales branch, with the inclusion of the new Romford depot, makes 37 service offices and stores covering the British Isles. The Derby branch will be managed by Mr. F. G. Shardlow.

Mrs. L. H. Butler opening the Derby sales branch of Walsall Conduits, Ltd. In the centre is Mr. F. N. Crabtree, district manager, and on the right, Mr. L. H. Butler, managing director

New Permali Factory at Gloucester

Over 200 guests were present on 4th October at the laying of the foundation stone of the new factory for Permali, Ltd., now being erected at Gloucester. The ceremony was performed by the Bishop of Gloucester in the presence of the civic dignitaries and representatives from local educational, technical and industrial organisations. Also present were representatives from amongst the users of the company's products and suppliers of raw materials. The building development, covering some seven acres of land adjacent to the company's original premises at Gloucester, is being undertaken by C.A.S. (Industrial Developments), Ltd., and completion is expected by September, 1957. The main purpose of this development is to permit centralisation of the manufacturing processes of various units within the Permali group of companies; it will also permit expansion of some of the newer developments.

The Bishop of Gloucester laying the foundation stone of the new Permali Gloucester factory

Glasgow Modern Homes Exhibition

The electrical industry was well represented at the Modern Homes Exhibition in Kelvin Hall, Glasgow, which opened on 3rd October. An attraction of the exhibition is the Glasgow Corporation's model houses in which underfloor heating is used. Speaking at the opening Mr. Thomas Johnston, former Secretary of State for Scotland, criticised the current restrictions on hire purchase. Equipment and labour saving devices were as vital as walls and plumbing in the creation of homes.

Many electrical manufacturing companies are represented and the South

of Scotland Electricity Board is demonstrating the conversion to electricity in six easy stages of an old-fashioned kitchen.

Copper in Ireland

Hopes of the rise of a copper-mining industry in Ireland were expressed in Dublin recently by Mr. W. Norton, Minister for Industry and Commerce. He spoke of the activities of groups of prospectors (including a Canadian concern) in various parts of the Republic. At Avoca one of these groups had spent over £500,000 and it estimated that it would have to spend a further £1¾ million before it could bring the mine into production. He also mentioned half a dozen other areas which were being explored.

Railway Electrification Lectures

In view of the topical importance of 50 c/s railway electrification in this country, a special course of six consecutive weekly evening lectures of advanced standard has been arranged at Woolwich Polytechnic (head of Electrical Engineering Department: G. F. Freeman, M.Sc.(Eng.), M.I.E.E., A.M.I.Mech.E.). The course starts on 24th October. The lectures will be delivered by Dr. H. von Bertele, A.M.I.E.E., F.Inst.P., of the Polytechnic, and by engineers of the British Transport Commission. The fee for the course is 10s.

World Ploughing Convention

Dale Electric (Yorkshire), Ltd., obtained the contract for carrying out the complete electrical installation at the World Ploughing Convention which is being held this week at Shillingford, nr. Oxford. There is an exhibition by the various tractor firms and implement makers and each of their stands has a supply of electricity. The installation consists of a sub-station, approximately five miles of overhead cables with many miles of other cable used for stand wiring, and heating and cooking on the various stands. The production, distribution and ultimate utilisation of electricity on the farm forms the display of the E.D.A., housed in the Association's cedar wood bungalow. The exhibit is divided into four main sections, illustrating by charts, diagrams and photographs some of the many uses of electricity on the farm.

Computer Manufacture

Five large-scale electronic computers are under test at the newest Ferranti factory at West Gorton and six further machines are in advanced stages of construction. The inauguration of a computer production line on this scale is an event of national significance since it is believed that no comparable effort in the computer field is to be found outside the United States of America. The West Gorton factory, which is still undergoing conversion, will soon provide some 300,000 sq ft of manufacturing space, of which 150,000 sq ft is allocated to the computer department.

The manufacturing activity is supported by research laboratories both in the factory and at Bracknell, near Ascot. These laboratories employ more than 100 development engineers. In addition, there is a computer centre at 21, Portland Place, London, where the main body of the Sales Division and a Computing Service are situated.

Ferranti, Ltd., have already manufactured ten large electronic computers and now have additional orders for 34 of these machines of a total value of over £2 million. Most of these orders are for the "Pegasus" and "Mercury" machines. Some of these now seen in the works are ready for immediate delivery and it is planned that about 25 computers will have been completed and delivered by the end of next year. The rate of output will be more than doubled during 1958.

Ferranti "Pegasus" and "Mercury" electronic digital computers under construction at West Gorton

Although this production is at the moment devoted mainly to computers for use in science departments of universities and the research laboratories of industrial concerns and other organisations, the extensive production facilities will make an important contribution to the manufacture of the joint Ferranti/Powers-Samas integrated data processing equipments. Computers are now well past the laboratory and experimental stage as regards both their manufacture and use. The range of uses is increasing rapidly and in many new directions.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £197 0s 0d
COPPER, H.C. Electro	ton £290 5s 0d
Fire Refined 99·70%	ton £289 0s 0d
Fire Refined 99·50%	ton £288 0s 0d
COPPER Tubes ..	lb 2s 9¾d
Sheet	ton £363 0s 0d
H.C. wire and strip ..	ton £328 5s 0d
LEAD, English ..	ton £115 15s 0d
Foreign	ton £114 0s 0d
MERCURY	flask £83 10s 0d
TIN, block (English) ..	ton £795 0s 0d
ZINC, G.O.B. Foreign	ton £95 15s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 3¾d
Sheet	ton £293 5s 0d
Wire	lb 2s 11¾d
PHOSPHOR BRONZE Wire	lb 4s 5¾d
PLATINUM	oz £34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 26¾d—26¾d

B.V.A. Abandons Price Fixing

Changes in the constitution and trading practice of the British Radio Valve Manufacturers' Association, with effect from 1st September, are announced. Pointing out that it abandoned its "stop list" and allied provisions some years ago, the Association says that it has now discontinued all arrangements for collective resale price maintenance on the part of manufacturers in consequence of the Restrictive Trade Practices Act. In future it will be left to individual manufacturers to maintain the prices of their valves if they so desire.

Hitherto "B.V.A. Prices" have been fixed by agreement of all manufacturers who are members of the Association and this policy has been abandoned. The Association points out, however, that from its knowledge of the industry, and in view of the present period of recession with continually rising costs, although prices are no longer to be fixed by agreement it does not follow that the prices of comparable valves and tubes will necessarily vary between one manufacturer and another in the immediate future.

Apart from this the Association is continuing its general policy, including technical collaboration between

the manufacturers, with the Services and in international fields. Members of the B.V.A. are: A. C. Cossor, Ltd., the Edison Swan Electric Co., Ltd., the Ever Ready Radio Valve Co., Ltd., Ferranti, Ltd., the General Electric Co., Ltd., the Marconiphone Co., Ltd., Mullard, Ltd., Philips Electrical, Ltd., and Standard Telephones & Cables, Ltd.

Lansing Bagnall Canadian Company

Lansing Bagnall, Ltd., of Basingstoke, Hampshire, have formed Lansing Bagnall of Canada, Ltd., Toronto, to promote sales and provide service and spares facilities for the parent company's entire range of equipment throughout Canada. Mr. P. A. Berry, formerly export sales manager, is to manage the business in Canada. Mr. P. W. Beardall, formerly Midlands area manager, has been appointed export manager, and the company has appointed Mr. H. Partridge, formerly senior sales engineer in the Midlands, as Midlands area manager.

Contractors' Year Book

We have received from the Electrical Contractors' Association, 14, Bedford Row, London, W.C.1, a copy of the 1956-57 "Electrical Contractors' Year Book" (price 21s including postage). This is in similar form to its immediate predecessor with the amendments and additions which have become necessary. A useful feature is the "geographical" arrangement of names of E.C.A. members, in addition to the alphabetical list and details of branches. A great amount of information of value to electrical contractors is embodied in the Year Book.

Modern Battery Depot

A modern battery supply and service depot has just been opened by Chloride Batteries, Ltd., at West Bromwich, Staffs., and Exide's Midland headquarters is now installed there after 34 years at Dale End, Birmingham. With a frontage of over 80 yd and a total floor area of 30,000 sq ft, the new single-storey building was designed by Exide's own Architect's Department.

Besides "Exide" car starter batteries and "Drydex" dry batteries, the new depot handles batteries for commercial and passenger service vehicles; "Exide-Ironclad" batteries for electric industrial trucks and road vehicles; Chloride stationary batteries and "Keepalite" emergency lighting equipment; and miscellaneous other types for all applications.

The building stands in Colliery Road close to the main Birmingham-West Bromwich trunk road. Two sets of twin power-operated folding doors constitute the main 26ft-wide entrances to the goods inward and outward areas which together form a transport bay over 100ft long and 26ft wide. A 30 cwt travelling electric hoist handles the heavier loads. Beyond the bay, linked by roller conveyors and an electric fork-lift truck, lie the stores with an uninterrupted floor space of more than 8,600 sq ft. The department, which runs the full length of the building, is over 50ft wide at its narrowest point.

The charging shop in the new Midlands depot of Chloride Batteries, Ltd. The equivalent of over 3,500 2 V cells can be charged simultaneously

At the rear of the premises are the works departments. The depot's 6·6 kV power supply is stepped down to 110 V d.c. in a transformer room by two mercury arc rectifiers with a total output of 600 A. In the adjacent charging shop are 90 circuits where the equivalent of over 3,500 2 V cells can be charged simultaneously. Beyond is a model repair shop equipped with the latest battery service plant in duplicate—drills, steamers, pneumatic group pullers, lead benches, washing tanks and roller conveyor assembly benches. At this end of the site is a 2,000 gal tank for the oil-fired space heating plant and a 2,000 gal bulk acid storage tank.

The office block, including the stores office and trade counter, is equally well designed. Besides a light and airy general office nearly 70ft long by 32ft wide, it has a conference room, staff mess-room, medical unit and automatic telephone exchange. The site will accommodate substantial extensions to the works departments and the office block is designed to take a second storey when the need arises.

This attractive full-colour sales aid emphasising the safety of Ekco "Thermovent" heating equipment, particularly where children are concerned, is now available to stockists

Method Study

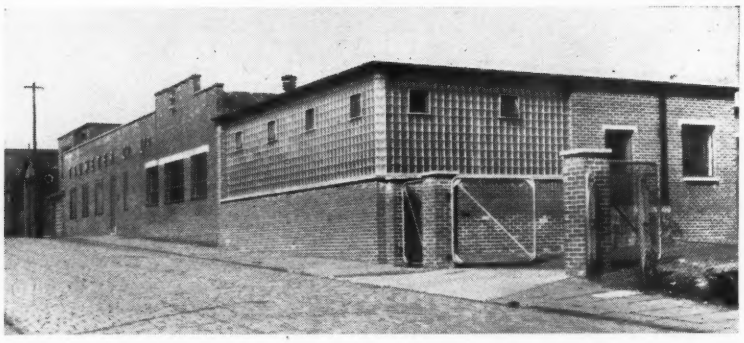
In its present-day sense, method study implies the deliberate and continuous examination of current practice, with a view to increased efficiency, economy and safety. Though this approach is relatively new, it is no less than twenty-five years since the Metropolitan-Vickers Electrical Co., Ltd., established its Method Study Department, and to coincide with the quarter-century mark a method study exhibition was opened at the company's Trafford Park Works on 4th October. Primarily intended for employees of the M.-V. group, the exhibition illustrates the wide range of activity to which method study can be applied with advantage and explains the company's method study training programmes.

Transatlantic Telephone Cable

In the article on the transatlantic telephone cable in our issue of 28th September reference was made to the two-way cable across Newfoundland between Clarenville and Terrenceville. We should have mentioned that this cable was supplied to the British Post Office by W. T. Henley's Telegraph Works Co., Ltd.; it was made for Henley's by Southern United Telephone Cables, Ltd.

Trumeter Extension

In 1933 the Trumeter Co., Ltd., manufacturers of counters, was established in modest premises in Manchester, and purchased several acres of land in Milltown Street, Radcliffe, with an eye to future development. The new buildings were opened in 1945, and the company carried on business from two addresses until 1951, when an



The new extension of the Trumeter Co., Ltd., at Radcliffe

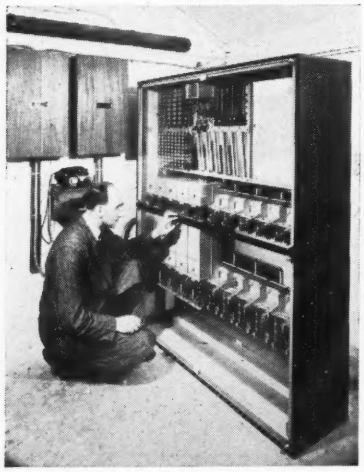
extension was built and the business concentrated on the Radcliffe premises. A further extension has now been made to accommodate a larger assembly department, where ample light is obtained by the use of glass bricks for the outer walls. The accompanying picture shows the premises as completed up to date.

Iraqi Contract

With reference to the note published in our 28th September issue regarding the contract received by the Brush Group, Ltd., from the Baghdad electricity authorities, we are informed that the Mirrlees diesel engines will each develop 3,022 b.h.p. (12-hour rating) at 428 r.p.m.

College Telephone Exchange

Following the installation recently of a new private telephone system, students at the Bristol College of Technology are now able to study the working of a modern automatic telephone exchange at close quarters. The cabinet housing the automatic exchange equipment has been fitted with special plate glass screens to enable those studying telecommunications and allied subjects to see the Strowger "step-by-step" switching system under actual working conditions. Designed by Communication Systems, Ltd., to provide speedy internal communications between all departments of the College's engineering and building sections, the new exchange is extensible, and has an ultimate capacity of 200 lines. The College is at present undertaking an ambitious expansion programme, and the equipment is intended to meet future, as well as present, needs.



New automatic telephone exchange equipment at Bristol College of Technology

New Thermotank Company

Glass fibre reinforced plastic rods, bars, tubes and sheets will be produced shortly for the first time in quantity by Thermotank Plastic Engineering, Ltd., a new company recently formed by the Thermotank Group. The company states that quantity production will be made possible by the installation of specially-designed and patented equipment, machinery and processes at its Chapelhall Works, near Glasgow, and by the development of new manufacturing techniques. Mr. I. Stewart, chairman of Thermotank, Ltd., the group's parent company, is chairman also of the new concern with Mr. G. Cuming as managing director. Rods and bars with diameters ranging from $\frac{1}{4}$in to 1in will be available in continuous lengths, and tubes are to be produced with internal diameters ranging from 1in to 24in. Any section normally produced as a metal extrusion will also be supplied.

Control Gear Exhibition

Arrow Electric Switches, Ltd., is holding a private exhibition of its new range of motor control gear at the St. Enoch Station Hotel, Glasgow, on 16th and 17th October. Invitation cards can be obtained on application to H. A. McQueen & Co., 700, Argyle Street, Glasgow, C.3.

Claudgen "Perspex" Department

A new "Perspex" Department is now in operation at the Wembley factory of Claude-General Neon Lights, Ltd., to meet the need for greater production capacity created by the growing use of "Perspex" for sign making. The new department is housed in the new extensions to the Claudgen factory which were completed last autumn. The plant and tools installed in it include a routing machine with a cutter capable of rotating at a speed of 24,000 r.p.m. and a mobile hand-router with a cutter which turns at 16,000 r.p.m. The new department with its special equipment and large working area will be capable of manufacturing products as diverse as an all-"Perspex" letter, 10ft in height, and an order for 1,000 small window signs simultaneously.

Installation Planning

The Edison Swan Electric Co., Ltd., has published a booklet entitled "Planning Your Electrical Installation." Explaining the advantages of ring main circuits and the provision of a realistic number of outlet sockets per room, the booklet will be useful to those planning a new house or converting an old one. Supplies are available to architects, contractors and Electricity Boards for distribution to clients and customers, and can be obtained from the Siemens-Ediswan organisation at 38-39, Upper Thames Street, London, E.C.4.

Car Bulb Packs

The General Electric Co., Ltd., announces the introduction of two "Osram" stock packs for motor-car bulbs. Each of the new packs contains seventy-two 12 V bulbs of four different types, and the contents of both packs provide a full range of bulb replacements for most makes of post-war British cars.

Price Correction

The advertisement of Thorn Electrical Industries, Ltd., headed "Glamour" which appeared in our issue of 21st September, quoted the price of the "Atlas Softlight One-fifty" as 3s 6d tax paid. This should have been 3s 9d tax paid.

Trade Announcements

The Marconi International Marine Communication Co., Ltd., announces that the address of its offices in Belfast, previously at York Branch Dock, has been changed to Marconi House, 2, Corporation Square, Belfast (telephone: Belfast 22250).

Solus-Schall, Ltd., inform us that they have obtained the manufacturing rights in the United Kingdom for the Magnaflux Corporation of Chicago's patented fluorescent and magnetic inks, used in the detection of cracks, and the equipment with which to apply them. Solus-Schall are authorised to supply these materials and equipment throughout the British Commonwealth (except Canada) and in Europe.

Owing to the continuing expansion of the Electric Tool Division of **Alliance Wholesale, Ltd.,** new premises have been taken and the Division is now operating at 64/66, Newington Causeway, London, S.E.1 (telephone: Hop 4811).

High Voltage Impulse Testing of Transformers – 2

By G. H. HICKLING, B.Sc., A.M.I.E.E.*

The Significance of Chopped Waves

ALTHOUGH this second article† discusses principally the oscillographic records which are taken for the dual purpose of checking the applied voltage waveform and amplitude and for detecting any breakdown in the winding which may occur during an impulse test, it is necessary first to give more detailed consideration to one particular aspect of the impulse test itself, namely, the significance of the chopped waves.

It has long been appreciated that the abnormally high stresses, when a transformer of conventional design is subjected to impulse voltages, are those between coils due to the initial concentration of voltage across comparatively few turns at the beginning of the winding. This "wavefront stress" is not confined to the line end coils, but moves rapidly down the winding as a travelling wave of voltage. Although the wave is attenuated in so doing, the danger point may nevertheless be some distance from the line end.

The severity of this stress wave increases as the wavefront time is made shorter, being very roughly proportional to the steepness of rise of voltage. When chopped impulses are used, the winding, after first being subjected to a normal wavefront (though with 15 per cent increase in amplitude), experiences a few microseconds later a second much more sudden voltage swing equivalent to a wave "front" of only about 0·2 μsec duration. The wavefront and the chop each give rise to an inter-coil stress wave; that due to chopping, of opposite polarity to the wavefront stress, is of shorter duration but of considerably greater amplitude, at least for the first few coil pairs. This is shown by the typical oscillograms given in Fig. 1, recorded with a recurrent surge oscillograph.

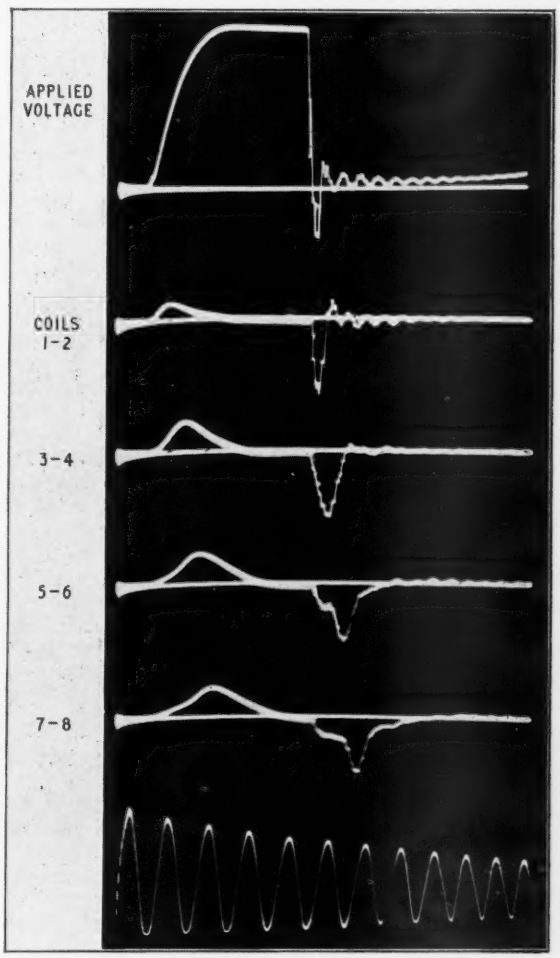
It is true that such oscillograms do not give a direct indication of the relative severity of the full wave and chopped wave tests. The chopped wave test affects primarily the coil and turn insulation whilst the major insulation to earth is still controlled mainly by the full wave test. With graded winding insulation, also, it is necessary in the first place to determine the point in the winding which is most highly stressed in relation to its actual insulation strength; and in addition appropriate allowance must be made for the shorter duration of the "chop" stress waves. Analysis is thus fairly complex, and the results of a full investigation which has been made of impulse stresses, in a large number of transformers, utilising recently extended data (as yet unpublished) on insulation breakdown time-lag factors, may best be illustrated by quoting typical numerical values. It has been shown that for a standard transformer of disc-coil construction to withstand a normal impulse test (including chopped waves) at the 550 kV full wave impulse level, its inter-coil insulation must be sufficient to meet a full wave withstand test of approaching 1,000 kV.

This comparison will serve to emphasise the importance of the disparity, noted in the first article, between the specifications of those countries which accept the chopped wave test and those which do not.

It has already been remarked that one of the two main arguments used against chopped wave impulse testing of transformers has been the supposed impossibility of detecting with certainty winding failures occurring on these shots; the other is based on the protective value of surge divertors, which are by no means in general use. The earlier methods available for impulse failure detection, it is true, made the discovery of faults which occurred only with chopped waves very unreliable, but it will be shown that with oscillographic techniques now in use, the testing engineer can be confident that insulation damage which may occur at any stage of the test will definitely be shown up. In what follows the chopped wave aspect of failure detection, particularly, will be emphasised.

Current practice in impulse testing requires the recording of at least two oscillograms on each impulse shot applied. An oscillogram of the applied voltage wave has

Fig. 1.—Chopped wave stresses. The impulse voltage is chopped after 4 μS. Inter-coil stresses (to same amplitude scale) are shown between coils 1–2, 3–4, 5–6 and 7–8 of a 132 kV transformer



* C. A. Parsons & Co., Ltd.

† The first article appeared in the *Electrical Review* of 31st August.

always been required and has in the past provided the most reliable information both on the actual amplitude of the test voltages and on whether any damage to the winding insulation resulted. In the last few years, however, as the result of extensive discussion of the subject in the technical Press, and especially of the interest taken in this subject since 1952 by C.I.G.R.E., it has been accepted that at least one additional oscillogram—usually of impulse current flowing in the tested winding—is necessary to provide an additional check on possible insulation failure.

The voltage oscillogram should logically be considered first, if only to emphasise, in view of the recent general interest in the various new "supplementary fault detection" recording circuits, that it does afford a very sensitive fault indication, particularly for the larger power transformers; only the rare minor inter-turn breakdowns or inter-coil flashovers remote from the line terminal will escape notice in this way.

Apart from the preliminary voltage calibration records taken to establish that the waveshape is within specified tolerances, a usual time duration for voltage wave records is about 40-50 μsec—sufficiently long to ensure that breakdown will not occur later than the interval recorded. Indications of failure on these oscillograms may be of three types: complete collapse of voltage, or an appreciable shortening of the wavetail, will occur in the event of a breakdown to earth or across a major part of the winding; voltage ripples on or after the wave crest may appear as the result of reflection back to the line terminal of the disturbance due to an inter-coil breakdown; and in addition there may be a "burst" of high-frequency oscillation at the actual instant of any fault. Fig. 2 shows a typical example of the second type of fault indication, obtained on a prototype 132 kV 30 MVA transformer.

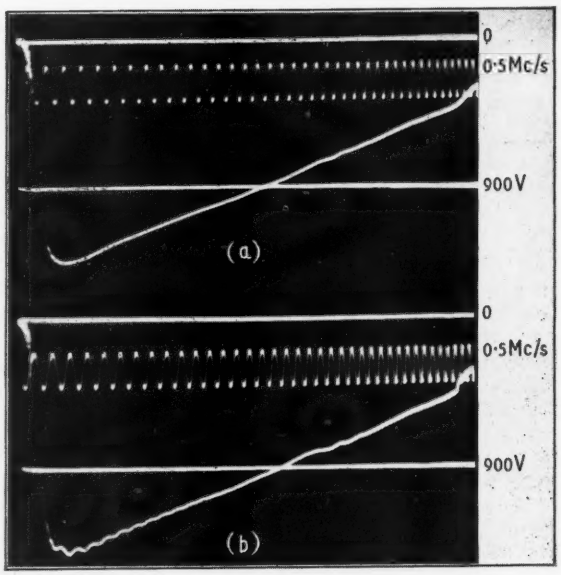


Fig. 2.—Impulse voltage oscillograms showing at (a) normal waveshape and at (b) inter-coil failure on a 30 MVA 132 kV transformer

"Neutral Current" Oscillogram

The more frequent demands for impulse tests on completed transformers brought about the realisation, some ten years ago, that more certain detection methods were needed, especially for detecting small inter-turn failures. Many methods were considered and have been tried out experimentally. In the U.S.A. and to a lesser extent in Great Britain, 50 c/s excitation of the transformer during test had already been tried in the belief that any impulse breakdown which occurred would be reinforced by power "follow-through" current and so made evident. This, however, proved ineffective, and although attempts have recently been made[1] to improve the method by loading the transformer, its use has generally been abandoned.

The first really useful step forward was the introduction by Hagenguth[2] of the "neutral current" oscillogram; i.e. a record of the impulse current flowing through a non-inductive resistance shunt connected between the neutral point of the winding on test, and earth. This method was shown to be extremely sensitive for even single-turn faults and appeared at first to be the complete solution to this problem—at least for full wave impulse tests.

Hagenguth's method utilised the effect of a short-circuited turn in reducing the inductance of a transformer winding by neutralising the core flux, and hence in increasing the build-up of inductive current $\left(i = \frac{1}{L}\int E dt\right)$ during the period of the applied voltage wave. It was found most effective to record the current waveform over a period of the order 200 μS.[6] As demonstrated by the application of permanent artificial short circuits, at least, the initial short-term oscillatory currents, associated with the winding stray capacitance, did not appear to be affected by a fault.

The test, in this form, suffered from the limitation that it was necessary to avoid short-circuiting other windings—particularly those on the limb under test—and this gave rise to further problems of avoiding undue voltage rises in such windings. More especially, the method failed to work effectively on chopped waves, this result being apparently inevitable since for this voltage waveform the quantity $\int E dt$ becomes negligibly small.

Despite this, it has recently been shown by Provoost[10] that the method can be made to function, even for a fault occurring after the chop, by using the charge stored in the winding up to the time of chopping.

Notwithstanding the drawbacks, the method was very widely used and also served to stimulate many independent researches on fault detection methods.[3-11] The principle of impulse current recording having once been established, other investigators studied oscillograms of this and related quantities in more detail, over various time durations and with different arrangements of winding connections. In particular, studies of neutral current and of "line" current (i.e. that recorded across a shunt connected between the insulated transformer tank and earth) were made on much shorter time scales, to determine whether changes in the "fine structure" of the wave at the actual instant of a breakdown could be observed.

Concurrently with these studies of the current waveform, various other oscillographic detection circuits were being tried, involving the study of induced voltages in windings other than that on test. Several of these methods[1,7,10] were based on the long period core-flux phenomena used by Hagenguth, faults being detected by changes in either amplitude or frequency of the voltage under observation. Another promising method, proposed by Elsner,[9] is that of recording on a shorter time sweep the capacitive current flowing from the l.v. winding (short-circuited and isolated) via a measuring shunt to earth. Mention may also be made here of the electro-acoustic method developed by Beldi[11] in which an oscillogram is obtained of the pressure wave in the transformer oil, set up by any sparking fault. The writer has recently developed a detector of this type which promises to give very satisfactory results.

The main practical outcome of the considerable effort put into this problem during the past decade has been the "wave method" of detection (this term being first used by Stenkvist[4] in 1952) in which, as the name implies, travelling waves of impulse current through the winding are principally observed; any insulation breakdown is found to modify these waves in a manner which can clearly be detected in the oscillograms. This is illustrated for full wave impulses by the typical oscillograms of Fig. 3 which include examples of both "neutral current" and "line current" recording, for actual inter-coil breakdowns at different positions in an experimental 33 kV transformer. Similar results obtained with chopped waves are shown by Fig. 4. In each instance sparking faults were obtained by artificially weakening insulation between coils.

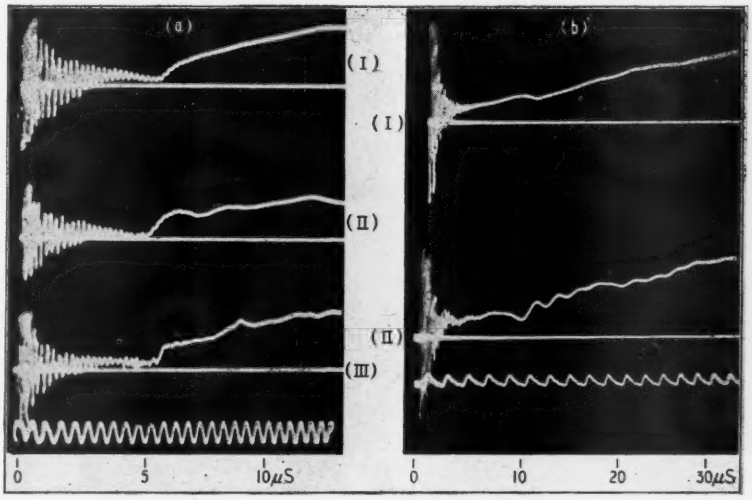
A general criticism must here be interposed, of all those methods which rely on the long period voltage or current phenomena associated with core flux build-up, as in Hagenguth's original method. These methods are likely to give very satisfactory results with small bobbin wound distribution transformers in which inter-layer breakdowns can be expected, mainly through solid insulation; but experience has shown that they may fail completely on large power transformers of the normal disc coil construction. In such windings inter-coil flashover may occur across cooling oil ducts on the crest of the very short stress wave (shown in Fig. 1), the arc extinguishing immediately this wave has passed—even though the full surge current is still flowing into the winding. This phenomenon was actually observed during tests made some years ago on a prototype 30 MVA 132 kV transformer, and no increase in the long period neutral current occurred although a fault was clearly shown by high-frequency disturbances on both current and voltage oscillograms.

Demonstrations of fault detection methods by means of artificially "assisted" faults are consequently not acceptable for the long-period detection methods, unless adequately proved also by full-scale breakdown tests. For many of these methods which have been published, such confirmation appears to be lacking.

The above observation has a close bearing also on the procedure adopted —following the introduction of Hagenguth's neutral current technique —for detecting the presence of any chopped wave insulation damage by relying upon "follow-through" breakdown on subsequently applied full wave shots. This procedure, though for a time generally accepted[6] *faute de mieux*, has for some time been regarded as unsatisfactory. Convincing evidence of its unreliability was obtained during the series of tests just referred to, when, following a full wave breakdown, a number of additional shots at voltages of 80 per cent to 95 per cent of the original breakdown value was applied without any recurrence of failure: only when the original breakdown voltage was reached did the fault recur. Thus if a fault is initiated only by the much higher stresses resulting from a chopped wave, it can obviously not be assumed that it will necessarily show up on a subsequent full wave of lower amplitude.

Chopped Wave Fault Indication

Evidently, then, such failures must be detected at the actual time of their occurrence. The application of the shorter-period impulse current recording techniques to chopped waves, however, led initially to the fairly general belief[4] that the resulting records were too complex to be of practical use. This conclusion was in part, no doubt, attributable to inadequate recording techniques; in part to

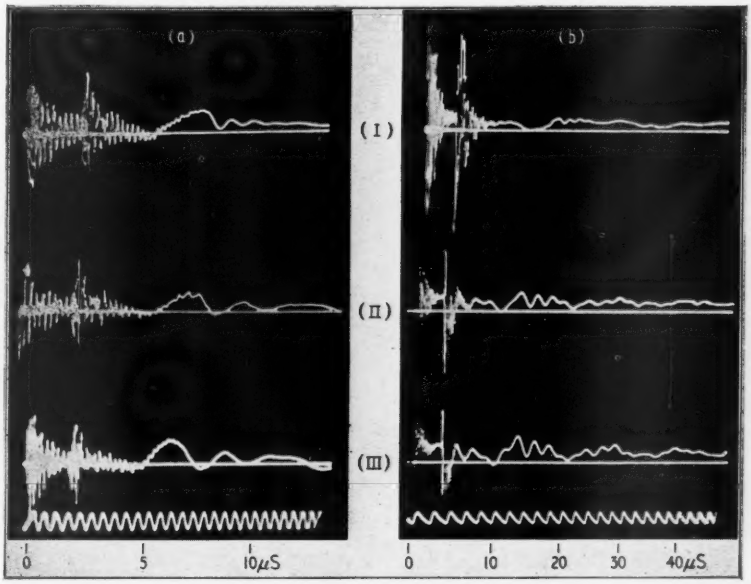


Figs. 3 (above) and 4 (below) show failure detection on full waves and chopped waves respectively. Oscillograms at (a) in each instance show "neutral current" and at (b) "line current" waveforms, recorded for the following conditions:—

Fig. 3.—(I) Normal waveform with no fault.
(II) Failure between coils 5 and 6.
(III) Failure between coils 41 and 42.

Fig. 4.—(I) No fault.
(II) Failure on chop stress only.
(III) Failure on wavefront stress.

Failures were in every case "assisted" faults caused by spacers of low dielectric strength placed between coils



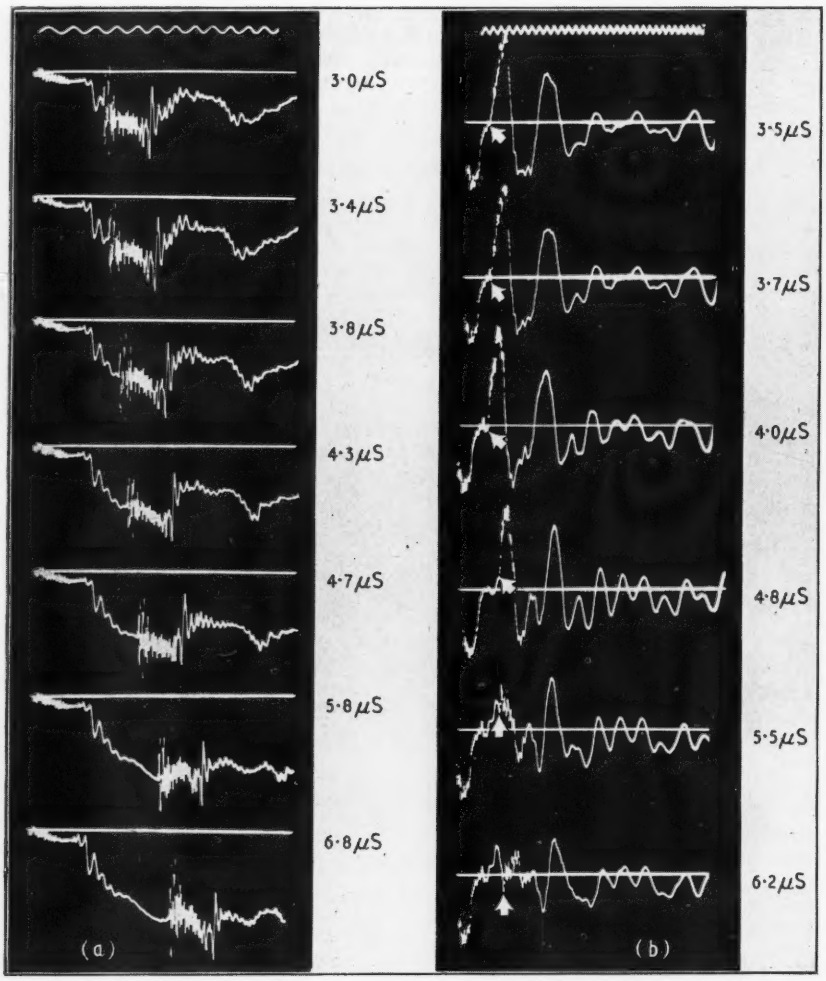


Fig. 5.—Neutral current oscillograms (chopped waves) showing effect of variation in chopping time (a) on a 120 kVA 33 kV disc coil transformer and (b) on a 120 MVA 275/132 kV layer type winding. The figures show chop time in microseconds and the arrowheads in (b) indicate actual instant of chopping; timing waves 1 Mc/s

the effects, discussed below, of variations in chopping time. Investigation of these methods continued, nevertheless, and it was later shown[12, 13] that suitably recorded chopped wave current oscillograms, when compared with reference waveforms recorded at reduced voltage, afforded evidence of failure quite as reliable as was obtained on full waves. With very little experience the records could be interpreted with equal facility.

The effect of variations in chopping time on the neutral current oscillograms is illustrated in Fig. 5. The series of records in (*a*) shows results obtained on a small disc-coil transformer, with progressively increased chop delay. As the writer has previously pointed out,[12] failure detection for this type of transformer is not dependent on absolute constancy of chop time, variations of which will be seen to have very little influence on the essential characteristics of the wave. The effect of a fault (shown by Fig. 4) is, by comparison, much more marked. If, nevertheless, the time of chopping for reduced and full voltage oscillograms can be made precisely equal (of which the possibilities will be discussed later) more satisfactory comparisons by direct superimposition are possible.

Somewhat different conditions arise when testing special " non-resonating " types of winding, specifically designed for immunity to impulse voltages, in which the normal travelling wave type of surge distribution is not obtained. Fig. 5 (b) shows a series of chopped wave current oscillograms recorded on a large high-voltage transformer of layer-wound construction, in which current oscillations of comparatively short period caused by the wavefront are combined, after the instant of chopping (shown by the white arrowheads), with a second series of oscillations due to the chop. The resulting complex wave is seen to be appreciably dependent on chopping time, which must therefore be accurately controlled to ensure precisely corresponding reference and full voltage oscillograms.

Some typical results showing the efficacy of chopped wave current oscillograms, exploiting the "wave method" of detection, are given in Figs. 6 and 7, in both of which oscillograph sensitivity was adjusted so as to give constant recorded amplitudes at all voltages. The former comprise records from a breakdown test made with controlled chopping time on a small disc-coil transformer, and include neutral currents recorded on two alternative time scales, together with the corresponding voltage waveforms. The current waveforms were perfectly consistent until the initial breakdown occurred, at which point the change in waveform (commencing at the instant when the " chop " stress reaches the neutral) is very noticeable. It is interesting to note that on a following shot the waveform deviation commences much earlier, indicating wavefront breakdown. Of more importance, the voltage oscillograms in this test give no indication that failure has occurred.

The oscillograms in Fig. 7 were obtained during official tests on a 120 MVA 275/132 kV transformer of layer type construction similar to that of Fig. 5b, and are included to show the very high degree of similarity obtainable between chopped wave current oscillograms at the full and reference voltage levels, when shots of identical chop time are compared. In each instance the bottom oscillogram (iii) is a composite print made from the two shots shown above it.

Although the stage has not yet been reached at which complete standardisation of impulse testing methods can be achieved, and it is clear from a study of the recent literature of the subject that many different failure-detection techniques are still being studied, certain methods have now been given general recognition and from discussions with engineers of several countries the general pattern of future impulse testing practice is becoming fairly clear. It may be said that the " wave method " of record-

ing, using either neutral current or line current, is in future likely to be the main method of failure detection, and will be used for both the full wave and chopped wave tests. Appropriate reduced voltage reference oscillograms for each waveshape will be obligatory. As a further requirement, accurate control of chop time, or at least accurate correspondence between full and reduced voltage shots, will be required; for whilst there is good evidence that any fault occurring on a chopped impulse will give rise to a recognisable change of current waveform, it is, of course, necessary to ensure that consistent oscillograms will be obtained on a sound transformer.

In addition to the current oscillogram and, of course, the voltage oscillogram as required hitherto, it seems likely that the recording of at least one optional additional fault detection oscillogram may be recommended. This may, for example, comprise a low-voltage winding capacitance current oscillogram or an electro-acoustic record obtained with a microphone and amplifier immersed in the transformer oil.

These proposals apply to large power transformers; for small multi-turn distribution units one of the sensitive long-period recording methods would be included.

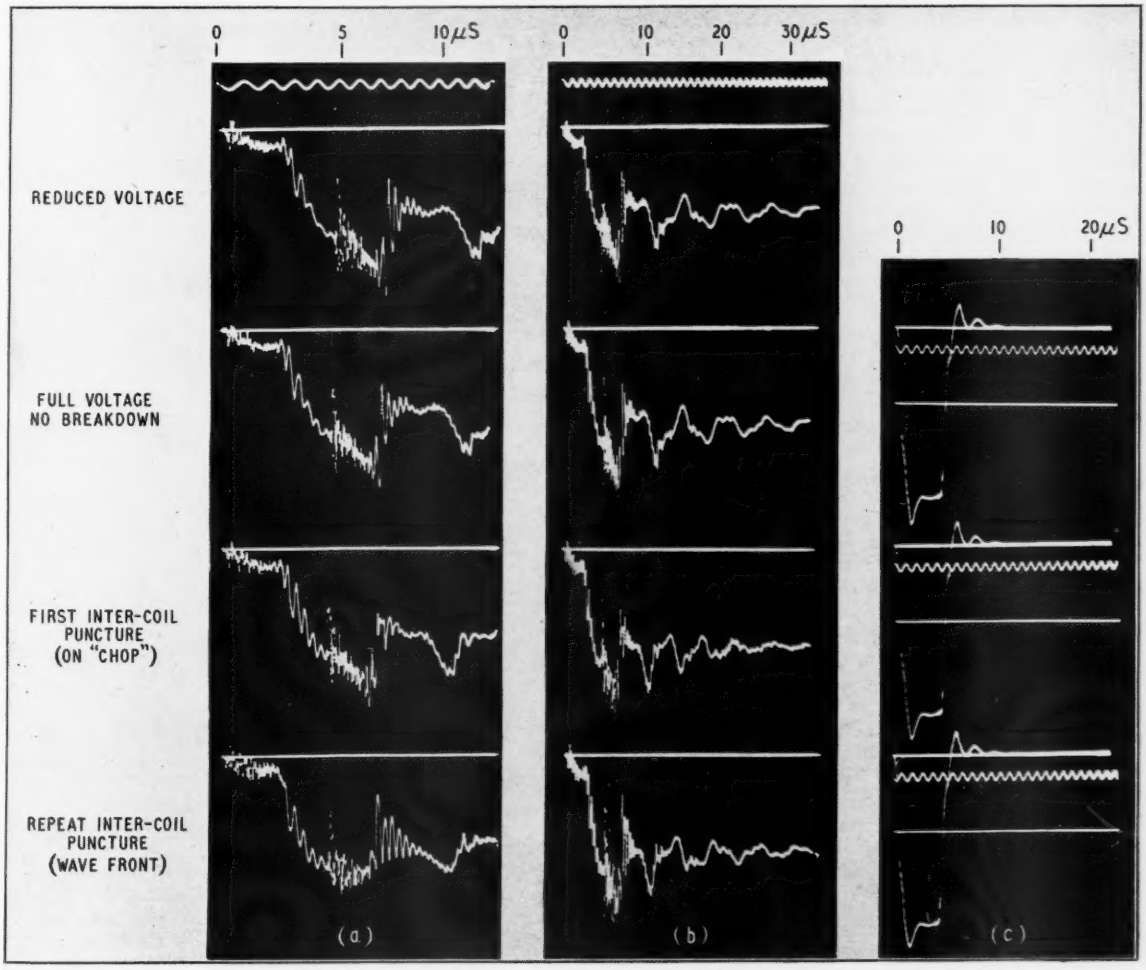
It has been suggested that in all chopped wave tests the chopping time should be standardised at, say, 3 μS $\pm$ $\frac{1}{2}$ μS, but with a maximum permitted difference of 0·1 μS between the full voltage and corresponding reduced voltage chopped waves in any one test. To comply with this requirement, which cannot be met when using the conventional rod gap, various forms of triggered spark gap have been proposed.

The writer has made tests on various forms of cascaded sphere gaps (one of which may be seen in Fig. 2, in the first part of this article) using electronic means of triggering. This followed work on similar lines carried out in France at the national laboratory of Electricité de France, in 1952.

More recently a much simpler form of triggered gap, comprising a simple modification of the sphere gap, has been developed in Germany.[14] This is ignited, via a delay line, by an auxiliary spark gap. The writer has verified that this device also will function substantially in accordance with the high claims made for it. Any of these devices will in fact, with care, control chopping time to 0·1 μS or better, this time being independent of the working voltage and gap spacings used.

If no controlled chopping gap is available it is possible to record, prior to the full voltage test, a series of reduced voltage chopped waves allowing a random variation of chop time, from which suitable comparison waveforms can be

Fig. 6.—Chopped wave impulse test to breakdown on experimental 120 kVA 33 kV transformer, using controlled chopping of impulse wave. The neutral current oscillograms ("wave method") have at (a) a sweep duration of 13 μS and at (b) one of 35 μS. At (c) are applied voltage oscillograms



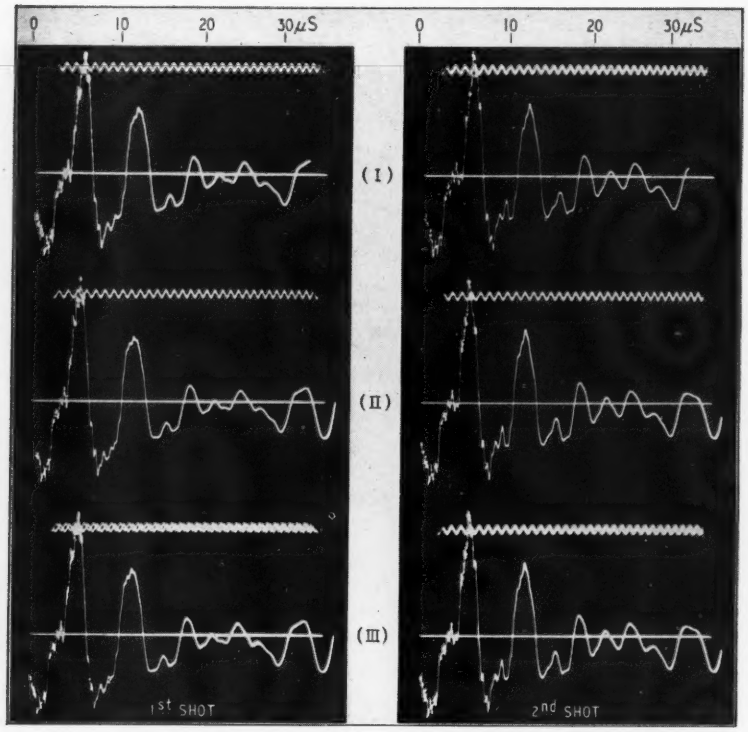


Fig. 7.—Typical chopped wave neutral current comparison from a commercial impulse test. Test on 275/132 kV 120 MVA auto-transformer showing at (I) 115 per cent chopped wave neutral currents; at (II) half-voltage reference oscillogram recorded with double voltage sensitivity; and at (III) waves (I) and (II) superimposed

selected. This technique was used for the records in Fig. 7.

Prior to the development of the triggered type of gap, various alternative proposals had been put forward in the U.S.A.[15] and elsewhere for chopping by means of sphere gaps to obtain consistency. All these methods suffered, however, from the necessity for adjusting the gap accurately for each test voltage used, consequently making it difficult to obtain close agreement between full voltage and reduced voltage shots, whilst in some of them a necessary adjunct was the increase of wavefront time to some 5 or 10 μS.

The more recent devices referred to above offer every promise of providing simple practical means of generating precisely controlled chopped impulse waves, and of enabling the generally unsatisfactory rod gap to be dispensed with. A prerequisite so far as impulse testing in Great Britain is concerned, however, is an amendment to the interim testing rules so as to define the chopped wave test in terms of chopping time rather than, as at present, in terms of the gap length of a "standard" rod gap. The present specification requires corrections to be made for atmospheric temperature, pressure and humidity and depends also on accurate adjustment of voltage for ensuring even approximate consistency in time lag. It is very desirable that such a change should be made now, before the rules are put on a more permanent basis as a British Standard. Since the suggested new definition of chop time involves no change in the actual test waveshapes, other than by fixing a more definite tolerance, no difficulty should arise in obtaining agreement on this point.

It would, however, be desirable that such a standard should go further, by giving a closer definition of the characteristics of the chop (viz. rate of collapse and "overswing") in the chopped wave test. It should also define such factors as minimum requirements for failure detection (with recommendations on the methods of fulfilling them) and should include some stipulation on the particular circumstances in which the 1/50 microsecond waveform tolerances may be relaxed. The principles on which such relaxations may be based were fully discussed earlier.

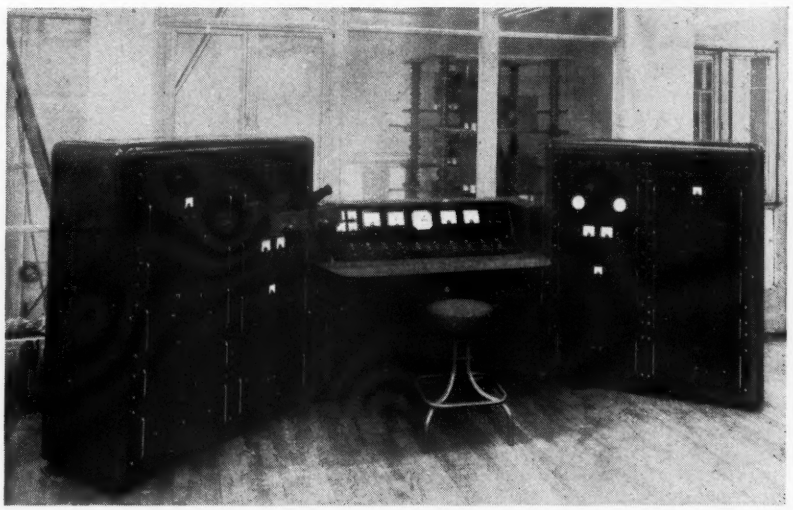
Whilst such a a change in specification is under consideration, the writer would further suggest (having regard to the wide difference between chopped and full wave stresses previously noted) adopting the proposal made recently by Rippon[16] to dispense with the 15 per cent overvoltage for chopped wave shots. This would materially simplify the actual testing routine since chopped and full waves could then be applied in succession with no further adjustment than to switch in or out the chopping gap trigger circuit.

Instrumentation

Having discussed some of the problems and some specific requirements for high-voltage impulse testing in a transformer factory, it is appropriate that this article should conclude with a few notes on the instruments and equipment in use at the present time for making such tests.

In both the oscillographic equipment and the electronic

Fig. 8.—Impulse control desk and recording units for a high voltage testing laboratory



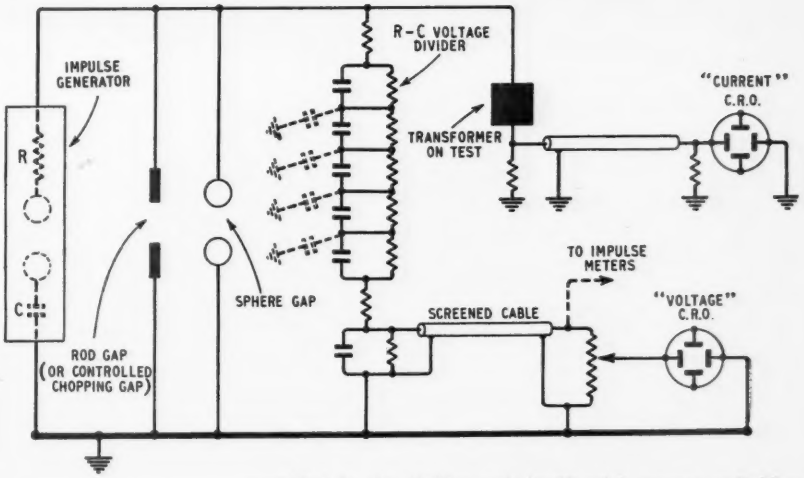


Fig. 9 (right).—General arrangement of impulse test and recording circuits

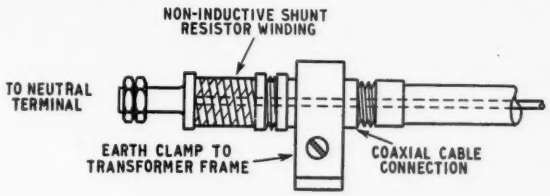


Fig. 10 (below).—Design for non-inductive shunt resistor for impulse current recording. The resistor comprises a double helix with opposite directions of winding—two sections in parallel. The measuring lead is completely screened by shunt winding and coaxial connector

monitoring instruments previously discussed, many improvements have accrued from the general advancement in design of electronic equipment in recent years. High-speed cathode ray tubes giving good resolution and requiring only moderate acceleration voltages of 10-25 kV are now available.[21] Developments in both electronic valves and circuit design have made available stable reference voltages, consistent linear time base circuits having negligible delay in starting, and also made possible the metering of very short duration pulses as described in the first part. Other circuit components have shown similar improvements. New polythene insulated cables are now readily available which adequately comply with the requirements of well screened low loss measuring circuits and at the same time withstand high surge voltages. They include special helical-cored delay cables which conveniently provide delays of the order 1/3 μS in lengths of only a few feet and with no noticeable waveform distortion.

Fig. 8 shows an impulse control desk and oscillograph unit recently installed in a high-voltage testing laboratory, in which many of these recent developments have been incorporated. Four recording channels are provided with a view to studying the various supplementary fault detection methods discussed above, concurrently with the standard voltage and current recording. Flat screen 10 kV sealed tubes of a well-proved type are used, with automatically operated 35 mm film cameras. Impulse voltage and waveshape meters are incorporated with indication on the central desk, in addition to a chart voltage recorder (not shown). Other features include automatic timing and tripping of the impulse generator—permitting the operator to concentrate on the more important aspects of controlling the test and recording—and remote operation and indication of all test gaps.

Usual facilities are provided for rapidly recording oscillograms with accurate time and voltage calibrations. The divider used for voltage measurements is of the R-C type shown in Fig. 9, which past experience has shown to be most suited to commercial impulse testing of transformers. Only two voltage ratios of 250/1 and 500/1 are provided in the divider unit itself, with remote switching from the control desk. All further adjustment is by means of a direct-reading attenuator on the c.r.o. panel, calibrated in overall ratios from 250/1 to 5,000/1, in 4:3 ratio increments. This facility for fine adjustment is used, both for impulse voltage and impulse current recording, in order that reduced voltage reference oscillograms and those at full voltage may be recorded with equal amplitudes, permitting them to be subsequently superimposed for accurate comparison. The question of voltage divider design and accuracy is considered outside the scope of this article. Several recent publications[17-20] are quoted in the bibliography.

Polythene coaxial cables of the type already mentioned are employed for all impulse measuring circuits, special matching arrangements allowing one or two oscillographs, as well as the electronic impulse monitors, to be operated from the voltage divider without interference. For the recording of impulse currents a specially designed form of shunt (Fig. 10) is used which has enabled spurious voltage " pick-up " to be reduced, even on chopped waves, to under 1 per cent of the measured amplitude.

Summary of Present Position

In conclusion, impulse tests performed on completed transformers before they are put into service, whether on all units manufactured or as type tests only, afford the most reliable method of eliminating insulation faults either in design or in manufacture. There are now no outstanding problems in making such tests on all types of power transformer, nor in the interpretation of the results, which need prevent the full benefit of such testing being obtained. Tests with both full waves and chopped waves, as at present used in this country, are necessary for adequately proving transformers for normal service, the latter wave being appreciably more onerous than the former on the line end coils.

The special problems of detecting failures with chopped impulse waves, whilst technically solved, may require the introduction of new equipment for the accurate control of chop time, to enable testing to be done most efficiently.

The issue of a British Standard to cover all aspects of impulse testing of transformers is overdue but first some amendment to the existing rules used by industry is needed; particularly a new definition of the chopped wave. There is also an urgent need for the international rationalisation of impulse testing specifications.

It has been shown that with proper impulse generator design and use, correct impulse waveforms should be obtainable on both h.v. and l.v. windings of transformers

of practically any rating, with voltages of 11 kV and over: for the lowest service voltages a full 1/50 μsec wave is in any case undesirable.

A number of problems remain open for further research; in the main, these concern the finer points of interpretation of oscillograms; the possibility of deducing the position of any recorded fault in the winding; the indication of corona discharges, both in and external to the transformer on test and with this the interpretation of some very minute disturbances detectable on recorded waveforms. There is scope also for the further study of fault detection circuits already in use, with various types of transformer, and perhaps for the introduction of new ones which may further simplify the interpretation of test results.

The author wishes to express his indebtedness to his various colleagues who have contributed largely to the progress reported in this article, and to the directors of C. A. Parsons & Co. for permitting its publication.

REFERENCES

[1] Provoost, P. G. C.I.G.R.E. Report No. 123 (1952).
[2] Hagenguth, J. H. *Trans.* A.I.E.E. 1944, Vol. 33, p. 999.
[3] Stewart, H. C., and Holcomb, J. E., *ibid.*, 1945, Vol. 64, p. 640.
[4] Stenkvist, E. C.I.G.R.E. Report 130 (1946) and Report 129 (1952).
[5] Wellauer, M. *Bulletin* S.E.V., 1947, Vol. 38, p. 149 and also in C.I.G.R.E. Report 113 (1948).
[6] Rippon, E. C., and Hickling, G. H. *Proc.* I.E.E., Vol. 96, Part II (1949), p. 769.
[7] Aeschlimann. C.I.G.R.E. Reports 118 (1948) and 112 (1950).
[8] Ganger, B. C.I.G.R.E. Report 125 (1954).
[9] Elsner, R. C.I.G.R.E. Report 101 (1954).
[10] Provoost, P. G. C.I.G.R.E. Report 115 (1954).
[11] Beldi, F. C.I.G.R.E. Report 112 (1952). Also Brown Boveri Rev. XXXVII (1950) No. 6, 179.
[12] Hickling, G. H. Discussion of C.I.G.R.E. Paper 123 (1952), Ref. 1.
[13] Hickling, G. H. "Precision Electrical Measurements," National Physical Laboratory (H.M. Stationery Office 1955), Paper No. 23.
[14] Auth, W., and Schindelin, H. *ETZ(A)* Bd. 76 H. 11 (1955), p. 386.
[15] Johnson, G. H. *Trans.* A.I.E.E. Power App. & Syst. (1953), Vol. 72, pp. 839–42.
[16] Rippon, E. C. "An Assessment of Impulse Testing." *Trans.* S.A. Inst. Elec. Engrs. (Feb. 55), p. 41.
[17] Howard, P. R. "Precision Electrical Measurements," National Physical Laboratory (H.M. Stationery Office 1955), Paper 18.
[18] Hylten-Cavallius, N., *ibid.*, Paper 22.
[19] Bochman, M., and Hylten-Cavallius, N. Technical Achievements of A.S.E.A. Research, 1946, Vesteras, Sweden.
[20] Aked, A. "Peak Voltage Measurements of Standard Impulse Voltage Waves." I.E.E. Monograph No. 153M (1955). (Proc. I.E.E. Part C.) See also *ibid.*, Bibliography.
[21] Hardy Jackson and Feinberg. *Elec. Engineering*, Vol. 28 (Jan. 56), p. 8.

LIGHTING AND SOCIAL HISTORY

AT the opening meeting of the new session of the Illuminating Engineering Society, which was held at the Royal Institution on Tuesday last, Dr. W. E. Harper was inducted as president. The theme of his presidential address was lighting and social history and he said that illuminating engineering, which at first sight might seem a child of the 20th century, had been fashioned down the long years by diverse social forces. The beginnings lay in the 13th to 15th centuries when cathedral builders used light playing on proportioned and decorated stone to evoke profound emotional response. The first use of artificial lighting in mines is recorded at that time and the English glass industry became firmly established.

By the 18th century commerce and industry were expanding and slowly people were being drawn from the land to the towns to meet the needs of developing trade. Street lighting became necessary and gas began to be used for lighting factories. The increase in overseas trade and movement of ships led to the need for navigational aids at night. As the new industrial society was fashioned so, unconsciously, it created a demand for artificial lighting matched to its characteristics; an organised lighting profession was still far off but social pressure was operating to that end.

In 1809 Davy demonstrated his arc lamps and later Faraday elucidated the principles of electromagnetic induction and opened the way to the electricity supply industry of to-day. In 1878-9 Swan and Edison produced successful lamps and the electric lamp industry was born. So, slowly, scientific research and industrial development forged tools to meet the demands for better lighting. Lighting as a service to society began to be appreciated and a lighting profession was demanded.

The period from 1900 up to the present might be called the years of achievement and opportunity. In 1909 the I.E.S. was founded and lighting instead of being a by-product of the gas and electricity industries became a formative power in shaping the social life of the people. After the 1914-18 war there were great social changes and in response to social demands advances were made in all directions. Advances in road transport brought an imperative demand for a new order in street lighting; air travel became established and the fundamentals of airport lighting had to be investigated; the production demands of industry called for higher levels of illumination and attention to problems of glare. Technical resources had expanded until the gap between demand and response had been bridged and to-day there was little which was not technically possible.

The present danger was that in our technical competence we might become complacent in outlook and approach. Modern life confronted the lighting profession with vivid claim and opportunity. In its contemporary context, said Dr. Harper, there were three principles which should mark the life of the Society: catholicity, authority and responsibility.

Tubular Fluorescent Lamps

THE British Standards Institution announces the publication of B.S. 1853, a revised version of the 1952 Standard for tubular fluorescent lamps. It applies to the type of tubular fluorescent lamps known as MCF/U with pre-heated cathodes, used in switch-start circuits, and is essentially a specification for testing batches of lamps for quality and interchangeability. An appendix contains detailed requirements for the colour, appearance and colour rendering of the light, and describes methods of testing.

The text of the revised Standard follows closely the international specification (I.E.C. Publication No. 81:1956) which is being issued by the International Electrotechnical Commission, but unlike the international specification, it does not include provisions for assessing the quality of the whole product of a manufacturer. The Standard, which is available from the B.S.I., 2, Park Street, London, W.1, price 4s, specifies methods of selecting lamps for testing and stresses that the tests apply only to the individual batches. A Standard for lamps used in circuits without switch-start will be prepared at a later date.

Fuel Efficiency Exhibition

Further Review of Equipment

AT the brief ceremony on 2nd October inaugurating the Fuel Efficiency Exhibition, which was held at Olympia from 2nd to 10th October under the auspices of the National Industrial Fuel Efficiency Service and the Combustion Engineering Association, the Minister of Fuel and Power (Mr. Aubrey Jones) emphasised the importance of adequate qualifications for boiler operatives and expressed the hope that more advantage would be taken of the City and Guilds course of training for them.

Proposing " Success to the Exhibition " at the subsequent luncheon, the Minister mentioned that this was the fourth national exhibition of its kind, the previous three having been held in Manchester. Nuclear energy, he said, could do no more for many years than supplement the supplies of coal and oil that were essential to industrial expansion. Before the war Great Britain consumed annually less than 10 million tons of oil but now the figure was nearly 25 million tons and the amount coming from the Middle East had doubled during the past five years. Western Europe had trebled its oil consumption within ten years and more than half came through the Suez Canal.

By more efficient use of coal in Britain 50 million tons should be saved annually. Only 10 per cent of new factory buildings were properly heat insulated. If the present incentives of loans and investment allowances failed, there was room for the price of coal to be raised, since imported coal cost up to £3 10s per ton more than the indigenous kinds, and compulsion to save might become a regrettable necessity. Sir Kenneth Hague (Babcock & Wilcox) responded, and a vote of thanks to the Minister was proposed by Mr. John R. Rylands (E. Green & Son) and supported by Mr. Christopher T. Brunner.

A forecast of apparatus to be on view at the Fuel Efficiency Exhibition that indicated the part played by electricity in promoting economy in the use of fuel was given in the *Electrical Review* of 28th September. Subsequent visits to Olympia brought to light other exhibits in the same category. These included, as before, plant used in the production of electricity, such as the models of boilers and other relevant equipment shown by Babcock & Wilcox and its subsidiary companies. Instruments for the boiler house and turbine room were seen on the stand of the British Rototherm Co., and portable and fixed power station cleaning appliances were displayed by the British Vacuum Cleaner & Engineering Co.

Oil-Fired Plant

The trend towards oil burning was indicated by the Esso Petroleum Co.'s technical advice bureau and by Shell-Mex & B.P. in demonstrations of a new method of low-temperature corrosion control. A practical example was provided by the Brockhouse Heater Co. in a method of damper control of a fan inlet to secure accurate quantitative air/oil relationship. A further instance was provided by Hamworthy Engineering in an automatic rotary oil burner, designed to give good atomisation without high temperatures and pressures and possessing modulating control over a wide operating range.

A working model showing a means of washing the external surfaces of an economiser on load was prominent among the exhibits of E. Green & Son. An automatic oil-fired boiler incorporating equipment for maintaining correct air-fuel ratios at all loads was displayed by G.W.B. Furnaces. Honeywell-Brown products were represented by measuring, recording and control instruments and a new general purpose room thermostat. Hopkinsons' exhibits of boiler mountings and valves included items for steam pressures up to 2,000 lb/sq in, and a Hopkinson-Ferranti stop valve with motorised control and equipment as supplied to atomic power stations.

Magnesia thermal insulating products for temperatures up to 650 deg F were displayed by the Chemical & Insulating Co. and in addition meta-dextramite and dextramite, with a magnesia base but good for 2,000 deg F. Copes Regulators had the application of a land-type feed-water regulator among its items and Copperad showed a comprehensive range of heating equipment. Automatic, thermostatic and electronic controls for heating plants were shown by Danfoss.

A notable feature of the Darlington Insulation Co.'s stand was the model of a reactor at Calder Hall nuclear power station, the thermal insulation of which was carried out by the company. Among the exhibits of Davey, Paxman & Co. was a rotary vacuum filter for the mechanical extraction of water from slurries and effluents hitherto dried in kilns. The main item contributed by Davidson & Co. was a double-inlet " Sirocco " centrifugal i.d. fan of a backward aero-foil bladed type, to be installed in a power station.

Control and Instrumentation

Demonstration units of " electromatic " relief valves and solenoid-operated steam valves were among the items displayed by Dewrance & Co. Means of automatic and electronic control and measurements of all kinds were exemplified by the Electroflo Meters Co. A representative display of basic instrumentation and control by Elliott Bros. showed a new application of an electronic viscosity meter to automatic boiler plants in a large power station. Fibreglass, Ltd., demonstrated the effective use of its method of heat insulation and Flexible Drives (Gilmans), Ltd., exhibited samples of equipment for descaling boilers and economisers.

A complete boiler-feed recording installation was shown under working conditions by the Lea Recorder Co. Oil meters with " Rotoplunge " variable-stroke pumps and indicating or recording instruments were to be seen on the stand of Measurement, Ltd.

Prominent among the exhibits of Metropolitan-Vickers was a working display of unified boiler control. Trends in design of a.c. and d.c. motors over a period of years were also indicated especially in relation to cooling; power factor control and load limitation equipment were also demonstrated.

Hurseal with its associates Gulf Radiators and Seal Draught showed additions to the range of oil-filled electric radiators, including a flameproof industrial type. Imperial Chemical Industries, in addition to large-scale models and photographs relevant to fuel economy in power stations, also exhibited the " Afloc " treatment for scale prevention, chlorine processes for water purification, heat exchangers and condenser tubes.

The Mirrlees Watson Co. concentrated on underfeed coal and coke burning stokers. Newalls Insulation Co. showed examples of thermal insulation for boilers, turbines and

piping. A combined air heater and economiser with soot blower was exhibited by Newton Chambers & Co.

The exhibits of the Permutit Co. included a replica of a fully automatic control system for ion-exchange water treatment. Prat Daniel (Stanmore), Ltd., showed a range of fan impellers and dust collectors for power stations.

The Rheostatic Co. presented three new Satchwell automatic controls for oil burners, one embodying a photocell protective device, and a new short-stemmed thermostat for regulating temperatures of liquids, which embodied a magnetically controlled micro-gap switch. Various kinds of thermostats were also exhibited.

A highlight of the stand of Ruston & Hornsby was a sectioned model of the power house at the new L.C.C. Beckton sewage disposal works, where eight gas turbines run on sewage gas. Senior Economisers exhibited economisers, including the welded type, for steam working pressures up to 2,500 lb/sq in.

J. Stone & Co. showed forced circulation water tube boilers of remarkable compactness. Industrial suction cleaners of boiler tubes were exhibited by the Tellus Super Vacuum Cleaner Co.

An off-peak floor-heating system represented the most recent introduction of Thermodare (Great Britain). The element of galvanised steel is enclosed in a p.v.c. sheath having an internal diameter more than twice that of the element, thus facilitating rapid withdrawal and replacement without disturbing the floor surface. The element is laid at a depth of 2⅜in in sheet steel ducting filled with sand giving a temperature up to 80 deg F which is reduced to 75 deg at surface level. Ronald Trist & Co. showed " Electricon " smoke density indicators and alarms, gland packings, feed-water regulators and Mobrey switches for electrically driven machines having moveable safety guards.

The United Kingdom Atomic Energy Authority featured a model of Calder Hall power station and showed possible variants in future designs, including the use of liquid sodium as a coolant. Another model was of the heat-exchange system of Dounreay breeder power station now under construction with its reactor " no bigger than a dustbin." The Central Electricity Authority indicated the progressive advance in thermal efficiency of steam power stations and presented details of the plan to construct twelve nuclear power stations by 1965. Basic principles of fuel efficiency were illustrated by the British Standards Institution, which emphasised that capital expenditure on heat insulation could be repaid within a year or two.

EFFICIENT USE OF FUEL IN INDUSTRY

OPENING the conference on 3rd October on " The Efficient Use of Fuel in Industry," which was organised in connection with the Fuel Efficiency Exhibition, Sir Graham Hayman, President of the Federation of British Industries, said that the world consumption of energy had doubled in the last 30 years and might well increase at a faster rate. Coal would remain the main source in this country, but increasing use would be made of oil. Atomic energy would provide no miraculous solution. Investment in fuel efficiency would be productive from both the individual and national points of view.

Mr. F. B. Karthauser (National Coal Board) said that coal was 20 per cent cheaper in comparison with other raw materials to-day than it was in 1938, but savings could be achieved only if, in addition to proper equipment, there were a change of attitude towards fuel efficiency from the firing floor to the board room. Fuel savings were 33 per cent if plant efficiency was raised from 50 to 75 per cent, figures that were realistic and typical. Fuel efficiency was a problem of co-operation between producers, manufacturers of plant, and users of coal, and one of managerial insight and control.

Mr. Nichol pointed out that by raising the overall efficiency from 35 to 50 per cent, industry could effect a saving of over 13 million tons of coal per annum or £100 million. Every company should employ someone, at or near director level, whose prime responsibility was the efficient use of coal and the continuous stimulation of interest in it. The engineer should be given, and avail himself of, every opportunity to expand his knowledge in this field. To-day, boiler operators were handling the most valuable of industry's raw materials, and so industry must train them to higher standards, either on the job or by using existing facilities.

In the discussion on Mr. J. I. Bernard's paper, an abstract of which appeared in our 5th October issue, Mr. L. Landon Goodman (British Electrical Development Association) commented that it was the job of managing directors to make money, not to save it, which no doubt partly explained the slow response of manufacturing concerns to fuel economy campaigns. Vital as it was to save fuel from a national viewpoint, fuel technology was only one part of production engineering. Other equally important parts had to be balanced such as plant layout, production design, instrumentation and control, materials handling and processing, working conditions and various labour aspects, such as the degree of skill required by operators controlling the process. Thus, a process which had not the highest fuel efficiency might give the highest production or overall efficiency.

Even to-day the full implications of the electric motor as a source of power were not fully realised. As a sub-divider of power an electric motor was supreme and unique. Accurately controlled drives could virtually be placed in any position to carry out not only rotary motions but operations such as pulling and pushing. The ratio of the cost of human energy to electrical energy was 480:1; a human horsepower-hour cost about £2 and an electrical horsepower-hour 1d. Mr. Goodman suggested that in this figure lay the key to productivity in the U.S.A.

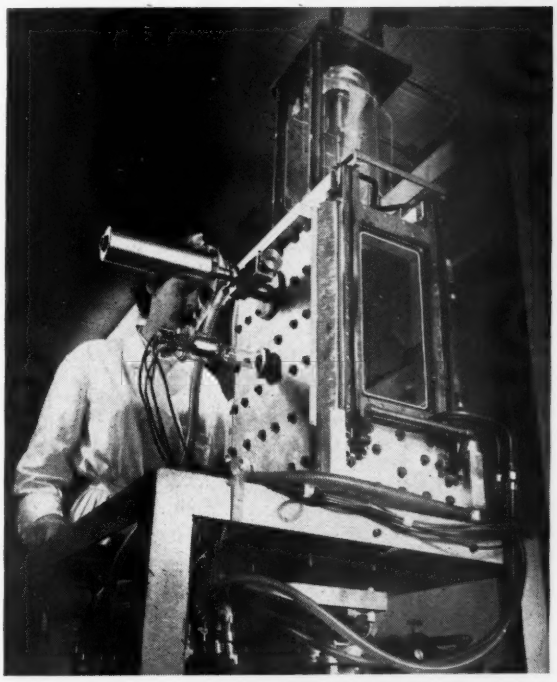
Mr. P. A. Lingard (London Electricity Board) said that Mr. Bernard had given valuable pointers to industrialists on where they should look for economy. Probably the greatest virtue of electricity was the ease with which it could be controlled, e.g., thermostatic control and timing control.

A process should not be allowed to contribute to the maximum demand if there was no need for it to do so. An alteration of two or three hours in a process might well make a great difference in the maximum demand. Heating represented a large proportion of the use of fuel in industry, a considerable part being space heating. Consideration should be given to the use of concrete block heaters in existing accommodation, if the premises were suitable, and to the installation of floor-warming cables in any extensions or new buildings.

Mr. Bernard, in his reply, referred to the North of Scotland Hydro-Electric Board's work in increasing the contribution from hydro-electric sources but said that Great Britain was not rich in hydro-electric resources. Atomic energy was a new source of electricity which would come into increasing importance in the next few years. Electricity saved not only fuel but also steel, as well as labour.

Colour Television Research

SYLVANIA-THORN LABORATORIES AT ENFIELD



Above: Silicon crystals for high temperature transistors are grown in this special furnace at 2,600 deg F

Right: Germanium crystals being ground to within 0·00001in for use in transistors

BRITISH research allied to American production techniques will bring colour television within reach of British viewers within ten years. This is the conviction of Mr. Don Mitchell, chairman and president of Sylvania Electric Products, Inc., of New York, and Mr. Jules Thorn, chairman of Thorn Electrical Industries, Ltd., manufacturers of Ferguson television receivers.

These views were expressed at the opening ceremony of the Sylvania-Thorn colour television laboratories, a joint Anglo-American project, at Enfield, last week. Mr. Mitchell said that in America they admitted that the best original research in new developments was done first, and often best, in Great Britain. What they did was to take the results of British research and run with it as fast as they could. Mr. Thorn and he hoped to take mutual advantage of the fruits of British research allied to American production techniques.

Existing American colour television must be greatly improved since the receivers were at present too complex and had far too many controls for the ordinary housewife to operate. The objective in these new laboratories at Enfield was to design a receiver at a cost comparable with black and white sets and equally simple to operate and maintain. Another field of research lay in solid state devices or semi-conductors, of which the transistor was one example. We might find, in the future, that there would be as many types of these devices as there were radio valves, and the development of each new type might open up a new field of application. Here again, Mr. Thorn and he believed that the best results would be obtained by allying British research to American production experience.

Because of the difficulties facing the research team, the laboratories at Enfield had to be specially built to their requirements; no ordinary building would have been suitable. Dust is an enemy of small-scale electronic equipment, so that elaborate air-conditioning and dust-filtration plant was essential. In the transistor assembly section dust particles down to one micron in diameter, invisible to the naked eye, are filtered out. Not only must the air itself be clean, the germanium in the transistors must be so purified that there must be less than one-millionth part of contamination. The practical difficulties of large-scale transistor production can be gauged when it is realised that a transistor consists of a slice of germanium 0·0002in thick, sandwiched between two slices of indium 0·0001in thick.

In view of the foregoing the building is not the work of

architects alone. It is the outcome of close collaboration between architects and research engineers who will be using the building. Because no research director knows what projects he and his team will be working on in years to come, the interior of the building has been kept flexible. All interior walls are made up from enamelled steel partitions which can be moved easily to conform to any layout required. All services are piped within the outside walls and leads for electricity and water can be taken at 8ft intervals from any point along them.

The main building is supported on piles running 38ft into the ground. Because vibration from the machines in the workshop must not interfere with the delicate laboratory instruments, the floor is a raft of concrete "floating" on a bed of clay. Where the walls of the workshop meet the floor there is thick cork insulation.

As a large quantity of cooling water is needed the lake in front of the building is both decorative and utilitarian. Used water from the cooling system is pumped through the ornamental fountains in the artificial lake and thus cooled before being drawn back into the system. The lake also provides opportunities for Thorn lighting engineers to demonstrate underwater illumination, and to light the fountains at night.

New Babcock & Wilcox Headquarters

THE new head office of Babcock & Wilcox, Ltd., was formally opened on Monday when Sir Kenneth Hague, managing director, unveiled a bronze plaque in the main entrance hall, in the presence of the chairman, Mr. W. Lionel Fraser, C.M.G., and directors of the company, together with guests representing those responsible for the building's construction.

This imposing eight-storey building is on the south side of Euston Road at the eastern corner of Gower Street over Euston Square Underground Station. It will accommodate some 1,500 members of the London staff, and will replace the present Babcock House in Farringdon Street, as well as Greenly House and Audrey House in Houndsditch, and other smaller offices in the City.

The building is equipped with the most modern facilities for the comfort of the staff, including a canteen based on the cafeteria system. Central heating is provided throughout the building by two "Steambloc" automatic, oil-fired "packaged" boilers supplied by a subsidiary company. The heat will be distributed through a piping system built within the floor structure which will enable an even temperature to be maintained on all floor levels.

Among other features of interest are a cinema, with 48 seats, for the showing of technical films and slides, and an exhibition room nearby for the display of models and exhibits illustrating the company's many activities. A special purpose technical library will maintain an up-to-date service of periodicals and publications relevant to the company's interests in all fields of industry.

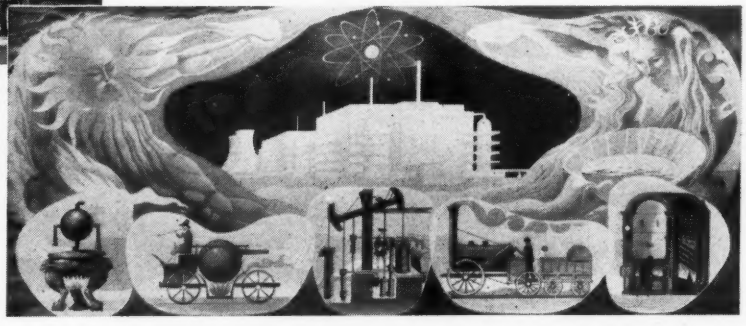
A Ferranti Pegasus electronic digital computer, to be installed in 1957, will provide a mathematical and scientific service for many departments. The great speed of the computer will allow many studies to be undertaken during the course of a contract which previously it would have been impossible to consider owing to the time factor. Programmes have already begun on boiler heat transfer, pressure losses and circulation. The computer will also be used to analyse piping stresses and steel structures and to solve nuclear engineering problems.

The growth of the Babcock & Wilcox organisation is impressively demonstrated by comparison with the first London office, barely seventy years ago, which consisted of a single room in a building in Newgate Street when the original staff comprised only three men and an office boy.

History of Steam Symbolised

In the interior décor of the entrance foyer the history of steam, and the benefits its power has brought to mankind in industrial and marine use all over the world, is symbolically illustrated in two large murals. In addition, three carved transparent edge-lit panels depict a mythical representation of fire, water and steam. The past is remembered as a progression towards an even greater future. The central motif is a striking representation of Calder Hall atomic power station foreshadowing the far-reaching future possibilities of steam in the application of nuclear energy to power generation. Mr. Eric Fraser, a leading artist in modern mural decoration, was commissioned to paint these symbolic representations.

The architectural design and layout of the building has been in the hands of Mr. Cedric Ripley, F.R.I.B.A., of Messrs. Waterhouse & Ripley, in association with Mr. Reginald W. Lone, F.R.I.B.A., F.R.I.C.S. The main contractors for the construction are Holland & Hannen and Cubitts, Ltd.



Front view of the new head office building of Babcock & Wilcox in Euston Road and (right) one of the two large murals in the entrance foyer depicting the history of steam

Smoke Abatement

CONFERENCE AT SOUTHPORT

THE three-day conference of the National Smoke Abatement Society which ended on Friday last was notable electrically chiefly for what it omitted. There was much discussion regarding what sort of fuel should be burnt in the domestic grate but no suggestion that combustion in the home might itself become out-of-date.

On the opening day, 3rd October, after a welcome by the Mayor of Southport, the President, Sir Ernest Smith, referred to the work of the Society in connection with recent legislation, and the responsibility which now rested upon the local authorities. An address on the Clean Air Act was then given by Mr. Enoch Powell, Parliamentary Secretary to the Minister of Housing and Local Government. He said the Government's interest in smoke abatement was no new thing, and he indicated some of the steps which had led to the passing of the Clean Air Bill in July last. He then outlined the various stages by which it was hoped that its provisions would be implemented and smoke-controlled zones established. The Clean Air Council, of which the Minister would be chairman, would shortly be appointed. Although the provisions for the prevention of dark smoke, grit and dust, provisions mainly affecting industry, would not come into force until the spring of 1958, people must not wait until then to do something about their problems. Neither should they assume that the seven-year period of grace allowed any general exemption from the prohibition of dark smoke during the period.

It would afford only a limited defence—limited in scope and limited in time, said Mr. Powell. To establish the defence, it would be necessary to prove that the emission of dark smoke was due to the nature of the building or its equipment and not to lack of maintenance or improper use, and that the necessary alterations or new equipment could not have been completed by the time the contravention occurred.

Gas Board Chairman's Views

The afternoon session was occupied by four progress reports which were taken in pairs. The first two were on "The Health Aspects of Air Pollution," by Dr. P. J. Lawther, and on "Air Pollution from Road Vehicles," by Dr. Handley B. Howell. The third report entitled "The Way to Clean Air" was by Mr. D. P. Welman, chairman of the North Western Gas Board, and in his absence was introduced by Mr. Hodkinson, the Board's chief technical officer. Starting with the somewhat surprising assumption that electricity and oil would only succeed in doubling their supplies in the next fifteen years, he said that this would merely suffice to supply the *increase* in the domestic heating requirements (estimated at 13 million tons of coal equivalent per annum). Hence the existing domestic requirements would have to be met by solid fuel, which—in the new smoke-controlled areas—would mean coke. The paper suggested that this could be done granted two things, namely, an expansion of the gas industry by between 2 and 5 per cent per annum and a diversion to this industry of some of the 75 million tons of carbonising coals now burned in open grates or used for steam raising and other purposes. Where these other users would obtain the coal to take the place of that diverted from them was not indicated.

The paper accepted the fact that coke was unlikely to give satisfaction unless burned in a modern appliance, and went on to describe two fuels developed by the Gas Board for burning in existing grates.

The last report, on "Developments in the Production of Solid Smokeless Fuels," was by Dr. W. Idris Jones, Director General of Research of the National Coal Board. The whole range of smokeless domestic fuels was described, but no great hope was held out that the production of any of these or all of them together could be so stepped up as to meet domestic smoke prevention requirements. Moreover, the treated products would inevitably cost more per unit of calorific value and the consumer had yet to be convinced that they were worth paying for.

The discussion which followed these two reports dealt almost exclusively with the relative merits of solid domestic fuels but Mr. J. W. Moule (South of Scotland Electricity Board) was able to point out that Mr. Welman's figures appeared to be based on a faulty assumption so far as the electricity supply industry was concerned.

Cost of Conversion

The Thursday morning session of the conference dealt with "Local Authorities and the Clean Air Act." Alderman Goulden, Salford, gave some figures of the capital cost of converting 1,158 premises to smokeless burning, from which it was estimated that the cost of such an operation throughout the black areas would be about £175 million of which some £77 million might fall on local authorities. Mr. H. V. Cass, chief sanitary inspector, Oldham, dealt with the enforcement problem, whilst Professor A. B. Semple, Liverpool, showed a number of alarming illustrations of the smoke nuisance in that city.

The afternoon was devoted to the subject of "Clean Air and the Housewife," and papers were given by Mrs. Mary Courtney, J.P., Miss Judith Ledeboer and Miss Akester. A number of very practical points were dealt with including the high price and large bulk of many smokeless domestic fuels. As before, the discussion turned very largely on what to put into the domestic grate and it was left to Mr. Scott (Yorkshire Electricity Board) to point out that heat could also be applied at other points such as under the floor, and to give some recent figures of the running cost of electrical installations.

On the last morning the seventh Des Vœux Memorial Lecture was given by Sir Hugh Beaver with the title "Clean Air: the Next Step." In the course of a vigorous and statesmanlike address he said that in order to make the new Act effective, local authorities would need additional technical staff and there would have to be research and agreement on various aspects of its application. A time limit should be put to the acceptance of the defence that installation of smokeless equipment was uneconomic because the old plant was soon to be replaced. If the aim of establishing the smoke-controlled areas within fifteen years was to be accomplished they would have to be brought in at a rate of 300,000 acres a year and, based on smokeless fuel, this would require an increase in production of one million tons a year.

Dealing also with things which the Act would not do Sir Hugh mentioned sulphur fumes and toxic gases of various kinds, road vehicle exhausts and other matters on which greater medical knowledge was needed.

GENERATION AND DEVELOPMENT

Cable laying operations in progress at Portland where the Dockyard distribution system is being modernised

Heating Appliance Restrictions

London borough councils are urging the Financial Secretary to the Treasury and the Minister of Fuel and Power to persuade the Government to lift the present hire-purchase restrictions on electric fires and similar heating appliances. The councils say that this should induce many more householders to install this form of heating and so help to create a cleaner atmosphere.

Another suggestion the councils are making is that no new restrictions should be imposed on capital expenditure by the Electricity Boards for the sale of heating appliances under hire-purchase arrangements.

Television Aids Traffic Control

Durham City Council, which recently used television as a means of controlling traffic at two important points in the city, is to obtain estimates for installing this system of control. During the tests, which lasted four days, television cameras were focused on two main entrances to the city centre and a television receiver, operating on a closed circuit, was installed in a control box in the Market Place, where the policeman on duty was able to see approaching traffic and operate traffic signals accordingly.

It was reported at a meeting of the City Council that the Ministry of Transport had expressed considerable interest in the television experiment and had recommended that estimates should be obtained for a permanent installation. The City Council is also investigating a scheme for using electronic detector pads for counting traffic.

Underground Gasification Plans

The National Coal Board has set up an Underground Gasification Executive to carry out in conjunction with the Central Electricity Authority the project for a pilot power station to be fed with gas from the underground gasification of coal. Dr. J. Bronowski, director of the Board's Coal Research Establishment, is one of the members.

Dockyard System Modernisation

An interesting cable installation for the Admiralty is at present being carried out on the Isle of Portland by Pirelli-General Cable Works, Ltd. The scheme for the reorganisation of the electricity supply system at Portland Dockyard was first planned in 1954 and called for a supplementary supply to be taken from the Southern Electricity Board. The new h.v. network within the naval base comprises an 11 kV ring connecting nine new substations, one section of the ring being taken across the Basin. In conjunction with the 11 kV ring a 54-pair dry-core pilot and telephone cable has been laid. From each of the substations a comprehensive medium-voltage cable system radiates to the various buildings.

The submarine cables connecting the Mere and Root substations, a distance of 1,100 yd, were laid from naval craft fitted with a special ramp apron for the purpose and manned by civilian personnel from the Boom Defence Depot at Gosport and the Dockyard, under the supervision of the contractors' engineer. The submarine power cable was laid first, marker buoys being attached to it to enable the pilot and telephone cable to be laid near to it on the following day.

In excavating for cable trenches the man-handling of solid blocks of stone weighing up to 2 tons was frequently necessary, as blasting in this area is prohibited. Owing to the very restricted access on one portion of the route it became necessary for drum lengths of 300 yd to be over-pulled for 600 yd along a railway embankment. Another part of the installation called for the laying of 100 yd of non-draining cable on a section of the rock face having an incline of one in four.

OVERSEAS

Australian Undertaking's Valuation

The Electric Light and Power Supply Corporation, Ltd., Sydney, has registered an emphatic protest at the legislation proposed by the State Government to deprive the company of its right, as declared by the High Court, to appeal against the valuation of the company's undertaking announced by the Land and Valuation Court. It points out to its shareholders that if the appeal were allowed to go on and favoured the company, it would result in the valuation being increased from £2,400,000 to £4,887,000, but the ultimate value fixed by the Court would under existing legislation bear interest at 3½ per cent a year.

Victorian Commission's Loan

Last week the State Electricity Commission of Victoria offered for subscription a loan of £A3·5 million at 5¼ per cent. The proceeds are to be devoted to fuel and power development.

Sydney Domestic Charges "Below Cost"

Our Sydney correspondent reports that a proposal to increase domestic electricity charges by 20 per cent from 1st October is being considered by the Sydney County Council. Quarterly bills for all-electric homes may rise by more than £2. The Rates Committee is expected also to propose smaller increases in industrial and commercial rates. It estimates that the higher charges will yield an extra £1,500,000 a year in revenue. Council members believe that, without the increases, the Authority will face a deficit of nearly £2 million next year. On present indications it may end the present year with a deficit of more than £700,000 instead of the £553,155 deficit for which it budgeted. The main causes are the cost of basic wage adjustments and a serious decline in industrial power consumption.

If adopted, the increases will be the most severe for years. Since July, 1954, the Council has progressively reduced power rates by a total of £1,601,000 a year. Only £203,000 of this, however, has benefited domestic consumers. Industrial and commercial consumers have gained the remainder, and the new increases will be directed at domestic consumers because County Council officers claim they are being sold power below cost. The decline in industrial consumption is blamed on the fact that large industries are finding it more economical to generate their own power. The Council has claimed that the Electricity Commis-

sion's charges for bulk sales to distributing authorities unfairly favour domestic users because charges for power used in off-peak periods—mainly by industrial and commercial users—are disproportionately high, while charges for power used in peak periods—mainly for domestic purposes—are too low. It has asked the Minister for Local Government, Mr. J. B. Renshaw, to appoint a panel to review the charges.

Yugoslavia to Export Power

A consortium of electric power companies to promote the export of hydro-electric energy from Yugoslavia is soon to be formed. This was announced by the secretariat of the United Nations Economic Commission for Europe after a two-day meeting in Geneva attended by representatives of Austria, the Federal Republic of Germany, Italy and Yugoslavia. The next meeting, for which representatives will prepare a detailed plan, will be held at the E.C.E. offices in Geneva, on 7th November.

The basic study of the so-called "Yougelexport" project, published early in 1955, demonstrated the possibility of building on Yugoslav territory four central hydro-electric stations whose production would be exported to Italy and the Federal Republic of Germany over a network of 380 kV power lines. The total exportable energy is around 4,300 million kWh and the cost of the entire project has been estimated at about $US377 million.

The fundamental basis for the project is the disparity between the utilisation of the hydraulic resources of the interested countries. Only about 3 per cent of the hydro-electric potential of Yugoslavia is now employed, while Italy, for example, will have reached the limit of its potential in a dozen years if, as seems likely, consumption in that country continues to double every ten years. Another favourable factor is that Yugoslavia can export power in the winter, the season when demand is the greatest. A further interest to Italy is the possibility that some of the power from Yugloslavia can be transported over a submarine cable to southern Italy.

Israel's Increased Output

During 1955 Israel's electricity output rose to 1,248 million kWh from 895 million kWh in 1954. In 1949 the total power production was only 329 million kWh.

Ffestiniog Pumped Storage Scheme

A MODEL of the Ffestiniog pumped storage scheme to a scale of 1/250 was recently open to public inspection at the Merioneth County Council Offices, Dolgelley. Mr. A. R. Cooper, controller of the North West, Merseyside and North Wales Division of the Central Electricity Authority, explained that the scheme would be a pioneer of its type in this country, and was believed to be the largest so far contemplated in the world. It was certain to command universal attention and would attract many technical visitors from overseas.

For a pumped storage scheme two reservoirs were required at a considerable difference of elevation. At Ffestiniog this requirement would be met by the enlargement of Llyn Stwlan as the upper reservoir, and by damming the Afon Ystradau to form the lower reservoir. The generating and pumping station would be constructed on the west bank of the lower reservoir.

The enlargement of Llyn Stwlan would be achieved by the construction of a dam on its eastern side, and in view of its situation much thought had been given to the design and general appearance of this dam, which would be a massive buttress type of structure built of concrete. On the water side of the dam two vertical shafts would be excavated and from the bottom of each two horizontal tunnels would be driven, emerging on the hillside at a portal a short distance above the generating station. The country between the Stwlan Dam and the tunnel portal would be unaffected by the works. Four steel pipes, each about 8ft diameter, would be laid from the tunnel portal to the generating station. These would be in deep cuttings so as to project as little as possible above ground level. As they were so short no intermediate concrete anchor blocks were required and thus a feature of hydro-electric stations usually criticised had been eliminated.

The lower dam across the Afon Ystradau valley at Tan-y-Grisiau would also be of concrete but of the gravity type with no buttresses. The spoil from the excavation of the dam would be disposed so as to conceal the downstream face with only a small section visible at each end.

The generating station on the west shore of the lower reservoir would house four units, each comprising a 100,000 h.p. turbine, generator and pump. These four units would each have a vertical axis to ensure that there would be the smallest size of station building above ground; in fact, two-thirds of the whole station would be below ground level. At Stwlan it was anticipated that the spoil from the dam foundations could be dumped in the bottom of the existing lake where it would be permanently submerged. Spoil from the shafts and tunnels would be disposed in a valley below the level of the tunnel portals. The spoil from the excavation for the generating station would be disposed on the shore of the reservoir south of the station.

After considering many alternative layouts it had been found possible to accommodate behind the generating station the transformers and h.v. switchgear. It was felt that in this position they would be least obtrusive, and it had enabled the Authority to defer, possibly for many years, the construction of the outdoor substation which was authorised by the Act. A double circuit transmission line of the Authority's standard design for 275 kV would leave the area in an easterly direction.

Scale model of the proposed pumped storage hydro-electric scheme at Blaenau Ffestiniog, North Wales

Financial Section

STOCKS and SHARES

FOREIGN affairs have continued to restrict activity and to induce caution in Stock Exchange markets. News at home from the company world has also encouraged a wait-and-see attitude on the part of the investment community. In the latter field it is the evidence of contraction in industrial profit margins which mainly preoccupies attention at present. Another factor contributing towards the subduing of markets is the considerable number of new capital issues now making their appearance. Among the largest of them, the G.E.C. issues involve some £14½ million new money; John Brown & Co. and Automatic Telephone & Electric are each raising more than £1½ million by share issues. Sums of this order are calculated to absorb a material proportion of the capital available for investment in the industrial market.

G.E.C. New Shares

A firm and active market developed in the new G.E.C. £1 ordinary shares, of which 4,285,320 are offered to existing stockholders at 40s. Having opened at under 2s, the premium subsequently went ahead to over 3s. The old shares rose by about 1s 9d, allowing for the deduction of the value of the "rights." The first call of 20s on the new shares falls due to be paid by next Friday, the 19th; payment of the remaining 20s does not have to be made before 4th January. Until then the shares will be transferable free of the usual 2 per cent stamp duty. In the absence of any official indication of the dividend likely to be paid on the increased capital, there is no very firm basis for calculating the prospective yield. At an all-in price of 43s for the shares, the return would work out at 6½ per cent if the rate were to be maintained at the full 14 per cent paid for 1955–56.

Excess Shares

With a number of new ordinary share issues now being made, or planned, by industrial companies, attention may be recalled to the invitation usually given to stockholders on these occasions to apply for "excess" shares in addition to the number allotted to them by way of rights. The excess arises because small numbers of stockholders usually neglect, for one reason or another, to take advantage of their entitlements. G.E.C. stockholders are invited to make such applications in connection with the current offer of new shares, and may note that the latter stand at a useful premium on the issue price. Excess share allotments cannot of course be expected normally to be on anything but a small scale.

Morphy-Richards

The 4s ordinary shares of Morphy-Richards have been changing hands up to 26s 3d (the official quotation remained at 25s) since the announcement of the annual results and of a proposed scrip issue. Earlier this year the price had been depressed below 20s by considerations of the effect of

Price Changes in

Company or Board	Nom. Value	Middle price 8th Oct.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1956 Highest	1956 Lowest
Gilt-edged Stocks								
Brit. Elec. 1968/73	100	74⅛	+1	3	3	4 0 6	80½	73⅛
Brit. Elec. 1974/77	100	72⅛		3	3	4 2 9	79⅛	71⅛
Brit. Elec. 1976/79	100	77⅛		3½	3½	4 10 3	84	77⅛
Brit. Elec. 1974/79	100	86½		4½	4½	4 18 3	95	86½
Overseas Electric Supply								
Calcutta Elec.	£1	19/3		6†	6†	6 4 9†	20/9	19/-
East African Power	£1	19/6x.d.	+3d	7	7	7 3 6	21/3	19/6
Nigerian Elec.	£1	17/6		10	10*	11 8 6	21/-	17/-
Perak Hydro-Elec.	£1	17/-	+6d	10	10	—	17/6	14/9
Equipment and Manufacturing								
Aberdare Cables	5/-	12/-		17½	17½	7 5 9	13/6	10/6
Aerialite	1/-	5/3	+3d	88⅛	45*	8 11 6	6/9	4/9
Allen, W. H.	£1	38/9		20	10*	5 3 3	39/-	33/6
Aron Elec. Ord.	£1	55/6	−3d	15	15	5 8 0	56/-	53/6
Assd. Automation	10/-	18/-		10	5	2 15 6	19/-	17/-
Assoc. Elec. Ord.	£1	63/9	+1/3	14	15	4 14 0	85/6	57/9
Automatic Tel. & El.	£1	57/6	−1/3	15	15	5 4 3	72/6	56/3
Babcock & Wilcox	£1	75/9	−1/9	15	15	3 19 3	85/6	64/-
Baldwin, H. J.	2/-	5/-		20	20	8 0 0	5/-	3/9
Bakelite	10/-	26/-	−6d	16	16	6 3 0	34/-	26/-
Berry's Electric	5/-	6/-		—	10‡	8 6 9	6/6	5/9
British Aluminium	£1	67/6x.d.	+3d	12	12	3 11 3	78/9	40/6
B.I. Callender's	£1	49/3	−3d	10	12½	5 1 6	54/3	45/-
B.I. Callender's 6% Pref.	£1	21/9		6	6	5 10 3	22/6	20/3
British Tabulating	£1	48/9	−1/3	9	9	3 13 9	51/3	37/3
British Thermostat	5/-	26/3x.d.		20	25	4 15 3	31/9	24/6
British Vac. Cleaner	5/-	8/-		30	15*	9 7 6	8/9	6/-
Brook Motors	10/-	35/-	+1/3	20	25	7 2 9	44/-	31/9
Brush Group	5/-	6/-		10	10	8 6 9	7/9	5/9
Bulgin, A. F.	1/-	4/9		45	50	—	5/3	4/3
Burco Dean	5/-	8/6		—	22½	13 4 9	13/6	8/3
Chloride El. Storage "A"	£1	63/-	+6d	17½	17½	5 11 0	73/6	60/9
Clarke Chapman	£1	118/9	−1/3	20	22½	3 15 9	123/-	89/6
Cole, E. K.	5/-	16/9	−6d	17½	17½	5 4 6	22/3	15/6
Cossor, A. C.	5/-	6/-	+6d	15	Nil	Nil	10/3	5/-
Crabtree	10/-	24/6		20	20	8 3 3	29/3	24/6
Crompton Parkinson Ord.	5/-	13/3		20	16*	6 0 9	15/-	12/3
De La Rue	5/-	16/6	−3d	30	30	9 1 9	20/3	15/-
Decca "A"	4/-	26/3		56½	43¾*	6 13 3	44/9	24/9
Desoutter	5/-	31/-		25	30	4 16 9	32/9	25/9
Dewhurst	2/-	6/-		24	30	—	7/6	5/3
Dictograph Tel.	2/-	6/-	+3d	20	20	6 13 3	6/9	5/6
Dubilier Condenser	1/-	4/6		25	30	6 13 3	4/9	3/6
Duport	5/-	18/9		23	25‡	6 13 3	21/6	13/9
E.M.I.	10/-	27/3	+3d	10	15	5 10 0	37/-	25/6
Electrical Components	5/-	15/-		25	25	8 6 9	16/-	12/6
Elec. Construction	£1	23/9		8½	8½	7 2 3	29/9	23/9
Elliott Bros.	5/-	28/9		19	17½*	3 0 9	36/9	24/6
Enfield Cable Ord.	£1	15/-	+9d	Nil	Nil	Nil	19/3	13/6
English Electric	£1	46/3		12½	12½	5 8 0	66/3	46/3
English Electric 3¾% Pref.	£1	13/-		3¾	3¾	5 15 6	14/6	12/6
Ericsson Tel.	5/-	38/-		20†	20†	2 12 9†	42/9	33/6
Ever Ready	5/-	28/9	+3d	35	35	6 1 9	32/9	24/-
Falk Stadelmann	£1	36/9		15	17½	9 10 6	45/9	36/9
G.E.C. Ord.	£1	43/9x.r.	+1/9	12½	14	6 8 0	65/6	42/6
G.E.C. 6½% Pref.	£1	22/-		6½	6½	5 18 3	23/9	21/3
General Cables	5/-	12/3		30	30	12 5 0	13/9	11/3
Greenwood & Batley	£1	46/3		17½	17½	7 11 3	47/6	45/-
Hackbridge Holdings	5/-	22/3		25	30	6 14 9	24/6	18/9
Hackbridge & Hewittic	5/-	17/6		30	23*	6 11 6	22/-	17/3
Heatrae	2/-	3/9		15	15	8 0 0	5/1	3/9
Henley's	10/-	16/3x.d.		10½	11½	7 1 6	19/9	14/-
Holophane	5/-	21/3		25	30	7 1 3	21/3	17/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend forecast.

the harder purchase-tax and hire-purchase regulations upon business in domestic appliances. Despite these, Morphy-Richards report in their preliminary statement for the year ended last June an improvement of some 14 per cent in the net group profit, after tax, to £245,000. This covers very comfortably the maintenance of the ordinary dividend at a total of 50 per cent, payable on capital increased by shares issued in part consideration for the acquisition of Astral Equipment during the year. The yield on the shares is around 8 per cent. It is proposed to distribute a scrip issue on a three-for-two basis, and to offer £500,000 convertible loan stock to ordinary stockholders.

Electrical Investments

Company or Board	Nom. Value	Middle price 8th Oct.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Equipment and Manufacturing—continued						£ s d		
Hoover	5/-	23/-		70	50	10 17 6	39/3	23/-
I.C.I.	£1	40/9x.d.	−1/3	10	10	4 18 3	49/9	40/9
Intl. Combustion	5/-	19/6	−6d	25	20*	5 2 6	25/-	15/3
Johnson & Phillips	£1	38/9	−1/3	15	15	7 14 9	46/6	37/6
Lancashire Dynamo	£1	41/9	−3d	15	11*	5 5 6	49/9	40/9
Laurence, Scott	5/-	15/3		12½	15	4 18 3	16/9	13/3
Lister, R. A.	£1	30/-		9·3	10	6 13 3	35/3	27/6
London Elec. Wire	£1	46/-	−3d	12½	12½	5 8 9	52/9	46/5
Lucas, J.	£1	31/3		7½	7½	4 16 0	40/3	29/6
Marryat & Scott	2/-	9/6	−6d	30	30	6 6 3	11/3	9/6
Mather & Platt	£1	55/-	−6d	15	15	5 9 0	65/3	51/6
Metal Industries	£1	21/-		9	9	—	27/-	16/3
Midland Elec. Mfg.	£1	45/-		10	12½	5 11 0	48/6	43/6
Morphy-Richards	4/-	25/-		50	50	8 0 0	27/3	20/-
Murex	£1	73/3	−6d	20	20	5 9 3	74/6	60/-
Newman Ind.	2/-	2/3		10	10	8 17 9	2/9	2/1
Oldham & Son	1/-	2/6		20	17½*	7 0 0	3/-	2/3
Parnall (Yate)	5/-	5/6		14	12	10 18 3	9/6	5/6
Parsons, C. A.	£1	86/3	−3/9	10	10	2 6 3	96/-	61/6
Plessey	10/-	68/-	−4/-	27½	30‡	4 8 3	87/6	56/-
Pye "A" Deferred	5/-	15/9	−6d	12½	12½	3 19 3	21/3	14/-
Reyrolle	£1	105/-	−6/3	15	16½	3 2 0	117/6	81/-
Rheostatic	4/-	9/9		18½	12‡	4 19 0	—	8/3
Richardsons Westgarth	5/-	16/-		16½	16½	5 4 3	17/-	13/9
Scottish Cables	4/-	15/9		27½	27½	6 19 3	17/9	15/9
Smith (England), S.	4/-	10/9	−3d	17½	17½	6 10 3	14/3	10/6
Southern Areas	£1	16/3		10	7½	9 4 6	28/9	15/-
Strand Elec.	5/-	7/9	−3d	15	15	9 13 6	8/6	6/9
Sturtevant	5/-	24/-x.d.		14·4†	15†	3 2 6†	31/3	22/6
Sun Elec.	£1	38/9		15	20	10 6 6	37/6	35/-
Switchgear & Cowans	5/-	14/-x.d.		20	25	8 18 6	17/-	13/6
Taylor Tunnicliff	5/-	11/9		15	15	6 7 9	14/-	11/3
T.C.C.	10/-	36/3x.d.	+6d	25	25	6 18 6	45/-	36/3
T.C. & M.	£1	27/-x.d.		8½	8½	6 6 0	34/-	26/-
Telephone Mfg.	5/-	7/-		10	10*	7 2 9	8/6	6/3
Thorn Elec.	5/-	16/9	+6d	15	15	4 9 6	22/6	16/-
Thornycroft	£1	45/6	+6d	15	15*	6 11 9	49/9	41/3
Tube Investments	£1	55/9	−1/3	22½	14*‡	5 0 9	70/6	54/9
Vactric	5/-	14/-		15	17½*	6 5 0	15/-	11/6
Veritys	5/-	9/-		12½	12½	6 19 0	10/-	6/9
Walsall Conduits	4/-	13/-	+3d	70	20*	6 3 0	13/6	10/9
Ward & Goldstone	5/-	39/6		30	35	4 8 6	39/6	29/-
Watford	2/-	7/-x.d.		25	25	7 2 9	7/6	6/-
Westinghouse	£1	72/6		18	18	4 19 3	100/-	71/6
West, Allen	5/-	12/9	+3d	15	15	5 17 9	14/6	11/6
Wolf Electric	5/-	17/6		20	20	5 14 3	26/3	17/6
Trusts, Transport and Communications								
Anglo-Portuguese	£1	21/9		8	8	7 7 0	23/6	20/3
British Elec. Traction: Def. Ord. "A"	5/-	18/6	+6d	22½	22½	6 1 6	20/-	15/6
Cable & Wireless: Ord.	5/-	10/6		10	10	4 15 3	11/3	9/6
4% Loan	100	90½		4	4	4 8 6	92½	88
Calcutta Trams	£1	26/3		6†	7½†	5 14 3†	27/6	23/-
Cape Elec. Trams	£1	16/3		8	8	9 17 0	20/3	18/-
Marconi Marine	£1	31/-		10	10	6 9 0	34/-	31/-
Oriental Tel. Ord.	1/-	72/6		16	—	—	90/-	67/6
Telephone Rentals	5/-	11/-	+3d	12½	12½	5 13 9	11/9	9/9

Crompton Parkinson

The final dividend declaration from Crompton Parkinson appeared last year, together with the preliminary statement of the results, in the last week of October. On that occasion the company reported a moderate expansion of earnings and brought up the distribution for the year on the ordinary shares to a total of 16 per cent, of which 6 per cent was described as bonus. This represented effectively the same rate as before, allowing for an intervening one-for-four scrip issue. The payment came from earnings equivalent to 43 per cent on the £3,871,000 ordinary capital. According to the report, the latest financial year, which ended in June, opened with the order book larger than it had been a year earlier, but with the prospect of narrower profit margins on much of the business. This year's interim dividend was 4 per cent, as before, and if the final distribution is also repeated there will remain a yield of just over 6 per cent on the 5s shares at a price of 13s 3d.

Automatic Telephone Issue

Particulars were due to go out to-day (Friday) to the ordinary and deferred stockholders of Automatic Telephone & Electric, inviting them to subscribe for 700,000 new £1 ordinary shares at 46s each, in the proportion of one for every three units held. The price of the existing ordinary shares went back a little to 57s 6d (after being 56s 3d) on the news, but this still left the prospect of a substantial premium on the new shares upon the beginning of dealings. The company has paid a regular 15 per cent for a number of years on the ordinary and deferred shares, with a 10 per cent scrip issue in 1954. The last distribution was covered more than four times over by available earnings.

Price Changes

A.E.I. shares at 63s 9d recovered something of the setback occasioned previously by consideration of the company's half-yearly progress report, and English Electric were steadier at 46s 3d. Others in the "atomic power" group continued on the down grade, Reyrolles losing 6s 3d, Parsons 3s 9d and Babcock & Wilcox 1s 9d over the week. Of the shares affected at present by merger proposals, business was recorded in Veritys up to 9s 9d, Elliott Bros. remained at 28s 9d, and Associated Insulation Products were 26s 9d. Aerialite, with the final dividend declaration due soon, improved further to 5s 3d, and others to display firmness included Brook Motors at 35s and Cossors at 6s, after the annual meeting.

REPORTS and DIVIDENDS

Morphy-Richards, Ltd., report a group profit before depreciation and taxation of £578,118 for 1956, against £472,728 for the preceding year and a net profit of £244,951 (£211,127). The ordinary dividend is maintained on slightly greater stock at 50 per cent by a final distribution of 30 per cent, £250,000 (against nil) is transferred to general reserve and £174,537 (£268,609) is carried forward.

After the annual meeting on 14th November a recommendation is to be submitted for the capitalisation of £389,235 from capital reserves and undivided profits and the distribution of a bonus issue of three new shares for every two held. The Capital Issues Committee has consented to the raising of additional capital by the issue of £500,000 convertible loan stock which will be offered for subscription to ordinary stockholders.

Lightalloys and Manganese Bronze.—The directors of the Manganese Bronze & Brass Co., Ltd., and of Lightalloys, Ltd., announce that proposals are to be submitted for the exchange of the whole of the issued share capital and the whole of the issued 6½ per cent convertible debenture stock of Lightalloys for ordinary shares of Manganese Bronze upon the following basis. For every two ordinary shares of 5s each of Lightalloys one ordinary share of 5s of Manganese Bronze. For every £3 of 6½ per cent convertible debenture stock of Lightalloys, five ordinary shares of 5s each of Manganese Bronze.

Newton Brothers (Derby), Ltd.—In the course of his address to shareholders on 1st October, Mr. F. V. Pipe (chairman) said that the net intake of new work in the past year was approximately 10 per cent above that of the preceding year, but prices had had to be cut to meet competition and conditions had been aggravated by increases in labour and material costs. Continental competition had become keener and export work amounted to 12 per cent of the total production, as compared with 18 per cent in the previous year.

The Automatic Telephone & Electric Co., Ltd., is to make an issue of 700,000 £1 ordinary shares to ordinary and deferred stockholders. The issue, which will raise £1·61 million, will take the form of a rights offer of one new ordinary share at 46s for each £3 of ordinary and/or deferred stock held. The issue has been underwritten by the Telephone & General Trust, Ltd.

Richard Johnson, Clapham & Morris, Ltd., announce a consolidated trading profit of £91,561 for the year to 30th June last, as compared with £86,421 for 1954-55. The net profit, before taxation, is £86,519 (£82,122). Taxation absorbs £42,241 (£37,893), general reserve receives £25,000 (£20,000) and the final dividend is 15 per cent, maintaining the year's distribution at 20 per cent.

The East African Power & Lighting Co., Ltd., has announced an interim dividend of 3 per cent (unchanged) on increased capital.

Ericsson Telephones, Ltd., is paying an interim dividend of 4 per cent, tax free (unchanged).

The London Electric Wire Co. & Smiths, Ltd., has declared an interim dividend of 3¾ per cent (same).

The Marconi International Marine Communication Co., Ltd., is again paying an interim ordinary dividend of 4 per cent.

Increases of Capital

Radcliffe Electrical Repairs, Ltd.—Increased by £15,000, in £1 ordinary shares, beyond the registered capital of £5,000.

Stewart Maggs, Ltd.—Increased by £5,000, in £1 ordinary shares, beyond the registered capital of £5,000.

New Companies

Microtest, Ltd.—Registered 2nd October. Capital £100. Electronic and electrical engineers and contractors, microwave testers, electronic equipment engineers and testers, manufacturers of electronic and electrical equipment, etc. Directors: B. Fleming and A. G. Hill. Sec.: B. Fleming. Regd. office: 24, Thames Street, Hampton, Mdx.

J. Featherstone (Electrical Contractors), Ltd.—Registered 1st October. Capital £1,050. Directors: J. Featherstone, Teresa Featherstone and Rex Featherstone. Regd. office: 39, Hallam Road, Mapperley, Nottingham.

Regam Electric, Ltd.—Registered 28th September. Capital £5,000. To acquire the business of electrical engineers, contractors and dealers carried on by L. Mager, at Leeds, etc. Directors: L. Mager and Mrs. Sarah Mager. Sec.: L. Mager, Regd. office: 39a, Boar Lane, Leeds.

R. L. Television Services, Ltd.—Registered 1st October. Capital £100. Electricians, radio, television, telephonic and telegraphic engineers, etc. Directors: G. H. Betton and J. S. Goodare. Regd. office: 54, Camp Hill, Birmingham, 12.

P. & L. Products (Northern), Ltd.—Registered 28th September. Capital £2,000. Electrical engineers, manufacturers of and dealers in electrical components, including electric blankets and heating apparatus, radio and television sets, etc. Directors: J. G. Peirson, Mrs. Cynthia L. Peirson, W. E. Lawman and Mrs. Frances D. H. Lawman. Sec.: W. E. Lawman. Regd. office: "F" Floor, Milburn House, Dean Street, Newcastle-on-Tyne.

W. H. Elmes & Co., Ltd.—Registered 17th August. Capital £1,000. Designers and manufacturers of and dealers in all kinds of electrical, nuclear fission, mechanical and scientific apparatus and instruments, including television and radio transmitters, etc. Directors: J. L. Ellis, Mrs. Marian A. Ellis and W. H. Elmes. Sec.: Marian A. Ellis. Regd. office: 349, Sharrow Vale Road, Sheffield, 11.

Plastic Tube & Conduit Co., Ltd.—Registered 1st October. Capital £1,000. Solicitors: Paisner & Co., 4, Gower Street, London, W.1.

L. & I. Clarke Lighting Agencies (Portslade), Ltd.—Registered 1st October. Capital £1,000. Lighting and electrical equipment agents and specialists, etc. Directors: L. W. Clarke, Ivy A. G. Clarke, G. W. Laker and L. Caplin. Sec.: Ivy A. G. Clarke. Regd. office: 49, Montpelier Road, Brighton.

L. & I. Clarke Travelling Lamps (Portslade), Ltd.—Registered 1st October. Capital £1,000. Manufacturers of electric travelling lamps, etc. Directors and other particulars similar to those of L. & I. Clarke Lighting Agencies (Portslade), Ltd.

Bankruptcies

D. Campbell-Kerr, formerly carrying on business at East Street, Mayfield, Sussex, as an electrical engineer under the style of the Warren Electrical Co.—Public examination 28th November at the Court House, Crescent Road, Tunbridge Wells, Kent.

C. R. Clarke, electrical contractor, lately trading at Kingham Way, Luton, Beds.—Public examination 8th November at the Court House, Stuart Street, Luton.

B. Dean, lately carrying on business at 2, James Street, Ebbw Vale, Mon., as a radio and television dealer.—First and final dividend of 3s 1½d in the £ payable at the Official Receiver's Office, County Court Buildings (First Floor), Westgate Street, Cardiff.

F. M. Hitchcox, lately carrying on business as an electrical contractor under the style of Burroughs Electrical Co., and as the B. E. Co., at 2a, Langley Road, Watford, Herts, and formerly from 18, King Street and 1, Church Street, Watford.—Application for discharge 16th November at the Court House, Town Hall, St. Albans, Herts.

H. H. P. Giles, lately carrying on business at 144, Brigstock Road, Thornton Heath, 30, Brigstock Road, Thornton Heath, and 54, Penge Road, East Norwood, Surrey, under the style of H. Giles & Son (a firm), radio and electrical retailer, container reclaimer, vinegar and pickle bottler, tobacconist and builder.—First and final dividend of 1 5/16d in the £ payable 16th October at 58-61, York Terrace, Regent's Park, London, N.W.1.

Liquidations

China and Japan Telephone & Electric Co., Ltd. — Members' voluntary winding-up. Meeting of members 30th October at Electra House, Victoria Embankment, London, W.C.2, to hear an account of the winding-up by the liquidator, Mr. A. W. Sarson, 5, London Wall Buildings, London, E.C.2.

D. R. Weir (Ewell), Ltd., electrical engineers, 5, Ewell House Parade, Ewell, Surrey.—First and final dividend of 3s 0½d in the £ payable at 11-12, Finsbury Square, London, E.C.2.

CATALOGUES AND LISTS

PUMPS.—Descriptive leaflet on the "PumPak" centrifugal pump set.—**Sigmund Pumps, Ltd.,** Team Valley, Gateshead, 11.

REFRIGERATORS.—Price list giving particulars of a reduction in purchase tax on the company's range of domestic refrigerators and leaflets describing the new "Continental" refrigerator and the model C.F.25 home freezer.—**Lec Refrigeration, Ltd.,** Shripney Works, Bognor Regis, Sussex.

SPACE HEATING. — Illustrated and priced folder giving particulars of the "Maxheat" tubular heaters.—**Wardle Engineering Co., Ltd.,** Old Trafford, Manchester, 16.

Leaflet describing an infra-red space heater designed for industrial premises.—**Ergon Electrical Manufacturing Co., Ltd.,** Vencourt Place, King Street, London, W.6.

TIME SWITCHES.—Price lists of the various types of time switches, including poultry and market gardening types, staircase switches and interval timers, etc.—**J. W Hughes,** 3, St. Thomas' Street, London Bridge, S.E.1.

WIRING ACCESSORIES. — Illustrated 60-page catalogue dealing with the Tenby range of switches, switch sockets and other wiring accessories, together with a separate price list.—**S. O. Bowker, Ltd.,** 19-21, Warstone Lane, Birmingham. 18

NEW ELECTRICAL EQUIPMENT

Liquid Level Switch

A new liquid level switch has been developed by TEDDINGTON INDUSTRIAL EQUIPMENT, LTD., Windmill Road, Sunbury-on-Thames, for the control and indication of liquid level in tanks, boilers, sterilisers and all types of industrial vessels. The switch (type WX) has no moving parts yet is capable of switching loads up to 5 A at 250 V a.c. without subsidiary amplifiers or relays. Since it requires no maintenance whatsoever it is particularly suitable for installation where the interior of the vessel being controlled is not readily accessible for cleaning or repairs.

The instrument operates on a difference in heat transfer between the sensitive element and the liquid in the vessel, or the sensitive element and the vapour, not on the difference in temperature or latent heat. It has a sensitive response, changes of level of the order of ½in being sufficient to operate the switch. It also provides an automatic surge damping effect since a positive change in level of sufficient duration to affect the heat transfer rate is necessary before the switch will operate. This eliminates short-cycling caused by momentary changes in level.

Switch Splitters

The latest addition to the "Crown" switchgear range to be announced by BILL SWITCHGEAR, LTD., Aston Lane, Perry Barr, Birmingham, 20, is a 30 A 250 V 3-way switch splitter, comprising one 30 A and two 5 A fuses and a d.p. slow break a.c. switch. The fuses are of the arc damping type, arranged for single-pole and neutral. Fuse carriers fitted with h.r.c. cartridge fuses are offered as an alternative and are interchangeable. The complete unit measures 5in by 6in by 2⅝in deep and it is obtainable in either a metal-clad case, finished in "Silverlose" enamel, or all-insulated moulded material.

Hand Torch

The new "Ray-O-Vac" "Handyman" type RT22 flashlight announced by ALPHA ACCESSORIES, LTD., Cae Mawr Factory, Treorchy, Rhondda, Glamorgan, is fitted with a novel push-pull ring switch which can be operated in any position. The torch measures 7½in overall and the brass barrel body is plated. A pre-focus bulb is fitted. The two "Ray-O-Vac" type 2LP batteries used are leakproof, being sealed in metal. The price of the torch, without batteries, is 10s 6d plus 2s purchase tax in the United Kingdom. The company also announces a reduction in the prices of its 9LP cycle battery (now 1s 9d) and 8LP "Bijou" battery (now 10d).

Hair Dryer

A new lightweight hair dryer, the "Duco" "Favourite," is announced by BROWN BROTHERS, LTD., Great Eastern Street, London, E.C.2. It is well-balanced, attractive in appearance and especially designed to avoid the possibility of overheating. The motor, which is interference free, is controlled by on/off and hot/cold switches. The heater has a loading of 375 W. The casing is of peach coloured moulded plastic and the total weight is 2 lb. Models are available for the 200/220 V and 230/250 V ranges and the price is £2 14s plus 11s 10d purchase tax in the United Kingdom.

An adjustable matching stand is also available at 17s 6d plus 3s 9d tax.

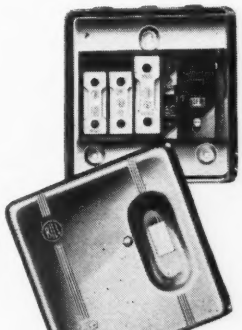
Fluorescent Fittings

A new and flexible series of fluorescent lighting fittings known as the Atlas "Atlantic" range is announced by THORN ELECTRICAL INDUSTRIES, LTD., 105-109, Judd Street, London, W.C.1.

The range, totalling nearly 400, is derived from a series of basic components which can be preassembled to form fittings for almost every kind of industrial or commercial application. Chassis design is constant throughout the series, the only variable factor being length. Made in 2, 4, 5 and 8ft sizes, each chassis can accommodate either one or two tubes with quick-start or switch-start control gear. Fixing can be by rods, chains or ceiling mounting, and special universal suspension with variable fixing centres can be provided with all fittings. The chassis units can also be coupled side by side to form multiple tube fittings as desired.

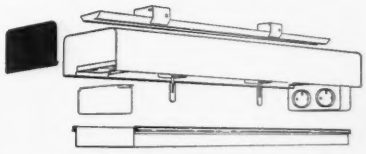
A newly patented spring-loaded lampholder in white plastic which enables bi-pin tubes to be used throughout is also announced. Flicker-shields are thus eliminated and the fittings can be placed end to end with a minimum dark area between. Snap-on "Perspex" diffusers, either plain or louvred, can be supplied with any of the single- or twin-tube chassis units (except the 8ft size) and for double banked chassis. "Perspex" trough fittings are obtainable and metal trough reflectors for industrial applications are available in all sizes. In addition to a standard stove enamel finish, Atlas "Miracoat" anti-corrosive finish can be supplied on the metal trough fittings. Vitreous enamelled trough reflectors are also obtainable. Each fitting is supplied preassembled and prepacked.

The "Atlantic" range, designed by Mr. John Reid, A.R.I.B.A., M.S.I.A., in association with the Atlas designers, will enable entire lighting schemes to be based on the one family of fittings —a feature of interest to architects, lighting engineers and contractors.



"Crown" 30 A switch splitter (Bill Switchgear, Ltd.)

Alpha Accessories "Ray-O-Vac" "Handyman" torch



Exploded view of the Atlas "Atlantic" fluorescent fittings chassis

Brown Brothers "Duco" "Favourite" hair dryer

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 17th October from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1952

2458. Ericsson Telephones, Ltd., Acton, J. R., and Revitt, W. A.—Electron-discharge devices. 30th January, 1952. (759255.)

2757. Technograph Printed Circuits, Ltd. —Variable capacitors. 30th January, 1953. (759134.)

10906. Standard Telephones & Cables, Ltd.—Automatic radio tuning circuits. 30th January, 1953. (759474.)

21972. Radio Corporation of America.— Colour television apparatus. 1st September, 1952. (759139.)

25145. Bendix Aviation Corporation.— Automatic electrical control systems. 7th October, 1952. (759141.)

25574. Igranic Electric Co., Ltd. (Cutler Hammer Manufacturing Co.).—Electric welding apparatus. 13th October, 1952. (759142.)

1953

1494. Arvin Electric, Ltd., and Cox, E. F. —Dry shavers. 18th January, 1954. (759485.)

2613. Thermionic Products, Ltd.—Magnetic recording media. 22nd January, 1954. (759486.)

5058. Briggs Motor Bodies, Ltd., and Russell, F.—Electric welding apparatus. 12th April, 1954. (759488.)

9936. Brennstoff-Technik Ges.—Process and equipment for the treatment of gases from low-temperature carbonisation, more particularly of coal, utilising electrostatic precipitation. 13th April, 1953. (759493.)

10052. Metropolitan-Vickers Electrical Co., Ltd.—Digital voltage measuring apparatus. 6th April, 1954. (759264.)

13672. Cinema-Television, Ltd.—Apparatus for scanning circular areas. 14th May, 1954. (759151.)

15037. Burroughs Corporation.—Electron-discharge devices. 29th May, 1953. (759153.)

15954. Kelvin & Hughes, Ltd.—A.c. electric motors. 10th June, 1954. (759495.)

16058. Simplex Electric Co., Ltd.—Electrical fuse assemblies. 11th June, 1954. (759,496.)

18901. Chambaut, H. L.—Rotary contact-making electric switches. 8th July, 1954. (759498.)

19587. Menzel, F.—Automatic voltage regulators. 14th July, 1953. (759499.)

21889. British Telecommunications Research, Ltd.—Electrical signalling apparatus. 20th July, 1954. (759269.)

26493. British Thomson-Houston Co., Ltd.—Electrical rectifiers of the contact type. 21st September, 1954. (759272.)

27242. English Electric Co., Ltd.—Electromagnetically operated valves. 1st October, 1954. (759171.)

28812. Permutit Co., Ltd.—Electrolytic apparatus. 12th October, 1954. (759275.)

29887. Siemens & Halske Akt.-Ges.— Electrical condensers. 29th October, 1953. (759511.)

30784. English Electric Co., Ltd.—Electric switchgear. 8th November, 1954. (759175.)

30802. Metropolitan-Vickers Electrical Co., Ltd.—Thermal power plant. 15th October, 1954. (759512.)

31563. General Electric Co., Ltd., and Krajewski, Z. A. A.—Thermometers. 11th November, 1954. (759381.)

32985. Philco Corporation.—Carrier wave modifying systems. 27th November, 1953. (759386.)

33410. English Electric Co., Ltd.—Blast tubes. 26th November, 1954. (759350.)

34569. Philips Electrical Industries, Ltd.— Magnetic rotary couplings. 11th December, 1953. (759389.)

1954

1009. Benjamin Electric, Ltd., and Smith, H. L.—Lighting fittings. 24th November, 1954. (759527.)

1737. Soc. Générale d'Applications Electro-Thermiques.—Process for heating magnetic materials by induction. 20th January, 1954. (759285.)

3189. Wickman, Ltd.—Means for use in the electro-erosion of electrically conductive materials. 5th January, 1955. (759190.)

4367. Johnson, Matthey & Co., Ltd.— Electrodes. 20th September, 1954. (759288.)

4981. Chanabon, E.—Electric connector sockets and contacts therefor. 19th February, 1954. (759534.)

5665. Electric & Musical Industries, Ltd. —Variable electric resistances or potentiometers. 28th February, 1955. (759398.)

5920. Brew & Co., Inc., R. D.—Bonding together of dielectric materials. 1st March, 1954. (759,200.)

7566. Kieft & Co. Ltd., C., and Kieft, C. W.—Snap-action electric switches. 16th March, 1955. (759539.)

8559. Bantam-Lite, Inc.—Electric battery lamps. 24th March, 1954. (759402.)

8589. International Business Machines Corporation.—Electronic commutators. 24th March, 1954. (759404.)

8608. Radio Corporation of America.— High power electron tube. 24th March, 1954. (759203.)

8801. British Thomson-Houston Co., Ltd. —Cover safety devices for electrical equipment. 25th March, 1955. (759204.)

8962. Sangamo Weston, Ltd.—Hermetic sealing arrangements for electrical measuring instruments. 10th January, 1955. (759542.)

9278. Magnetic Devices, Ltd. (Guardian Electric Manufacturing Corporation).—Electric circuit-breakers. 30th March, 1954. (759205.)

9301. Metropolitan-Vickers Electrical Co., Ltd.—Electrical meter movements. 30th March, 1955. (759299.)

9740. Licentia Patent-Verwaltungs-Ges.— Electric switching device, particularly an electromagnetic contactor. 2nd April, 1954. (759406.)

10212. Johnson, Matthey & Co., Ltd.— Electrical contacts and the manufacture thereof. 23rd March, 1955. (759407.)

10438. Electric & Musical Industries, Ltd. —Magnetic recording or reproducing apparatus.—7th April, 1955. (759408.)

10828. International Business Machines Corporation. — Electronic counters and accumulators. 13th April, 1954. (759547.)

11116. Compagnie Générale d'Eléctricité. —Devices for electrically insulating metal elements. 15th April, 1954. (759250.)

11673. British Insulated Callender's Cables, Ltd.—Arrangement for leading out electric wires from containers of apparatus and the like. 21st April, 1955. (759550.)

12618. Standard Telephones & Cables, Ltd.—Grid for electric-discharge tubes. 30th April, 1954. (759552.)

12963. British Oxygen Co., Ltd.—Electric arc welding. 19th May, 1955. (759213.)

13532. Garrett Corporation.—Electronic regulating apparatus. 10th May, 1954. (759553.)

13905.—Keroes, H. T.—Push-pull audio frequency transformers. 12th May, 1954. (759554.)

14576. Engineering Research Corporation, Ltd.—Electrical condenser. 18th May, 1954. (759556.)

17288. Standard Telephones & Cables, Ltd.—Light amplifying device. 11th July, 1954. (759420.)

17599. Union Carbide & Carbon Corporation.—Argon shielded arc welding. 15th June, 1954. (759422.)

20174.—Philips Electrical Industries, Ltd. —Circuit arrangements for use in television receivers. 9th July, 1954. (759565.)

21262. Philips Electrical Industries, Ltd. —Circuit arrangements employing transistors for controlling electric loads. 21st July, 1954. (759566.)

21821. Philips Electrical Industries, Ltd. —Level-control circuits for level-control in accordance with a pilot signal. 26th July, 1954. (759568.)

22199. General Motors Corporation.— Electrical devices for the ignition of cigars, cigarettes and the like. 29th July, 1954. (759569.)

22932. Schotz, S. P.—Cooling of electrical transformers. 20th October, 1954. (759572.)

23111. Bendix Aviation Corporation.— Variable frequency oscillating system. 9th August, 1954. (759573.)

23742. Eleetric Storage Battery Co.—Electric batteries. 16th August, 1954. (759432.)

23748. Allmanna Svenska Elektriska Aktiebolaget.—Electric high tension air-blast circuit-breaker. 16th August, 1954. (759574.)

23829. Van Der Heem N.V.—Electrically-operated air-blower assembly particularly for suction cleaners. 16th August, 1954. (759433.)

24269. Stackpole Carbon Co.—Electrical components to be connected to printed circuits. 20th August, 1954. (759322.)

24879. Zinc Products, Ltd. — Electric furnaces. 26th August, 1954. (759324.)

24962. Philips Electrical Industries, Ltd. —Methods and apparatus for manufacturing glass bulbs for cathode-ray tubes. 27th August, 1954. (759230.)

25128. General Electric Co., Ltd., and Rose, W. R. — Two-co-ordinate electromagnetic step-by-step switches. 17th August, 1955. (759434.)

25807. Philips Electrical Industries, Ltd. —Methods of manufacturing sintered permanent magnets. 6th September, 1954. (759231.)

28187. Akt.-Ges. Brown, Boveri & Cie.— Device for the protection of periodically operated contact devices against disturbances due to excessive or reverse current. 30th September, 1954. (759337.)

29600. Marconi's Wireless Telegraph Co., Ltd.—Radio mirrors and lenses. 12th July, 1955. (759442.)

29915. Automatic Electric Laboratories, Inc.—Automatic telegraph switching system with multiple call processing. 18th October, 1954. (759343.)

30314. Telefunken Ges.—Multi-stage valve amplifiers. 21st October, 1954. (759443.)

31311. Standard Telephones & Cables, Ltd.—Electronic equipment mounting arrangements. 29th October, 1954. (759446.)

33079. Philips Electrical Industries, Ltd. —Transformers. 15th November, 1954. (759452.)

33567. Standard Telephones & Cables, Ltd.—Electric capacitor. 19th November, 1954. (759454.)

33878. Specialties Development Corporation.—Electric switch operable by deformation of the housing. 23rd November, 1954. (759237.)

34347. Mullard Radio Valve Co., Ltd.— Tuned circuits. 26th November, 1954. (759459.)

36298. Westinghouse Electric International Co.—Multi-break electric circuit interrupters. 15th December, 1954. (759461.)

36751/2, 36756 and 37111. Philips Electrical Industries, Ltd.—Method of producing non-metallic magnetic cores having substantially rectangular hysteresis loops. 20th and 22nd December, 1954. (759244/6 and 8.)

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

Monday, 15th October

BIRMINGHAM.—Grand Hotel, 6.15 p.m. Birmingham Electric Club. "Nuclear Power," by J. C. Duckworth.

BRISTOL. — Electricity House, Colston Avenue, 6 p.m. I.E.E. Western Supply Group. Chairman's address, by C. J. R. Blackett.

IPSWICH. — Electric House, 7.15 p.m. Ipswich & District Electrical Association. "Atomic Energy," by T. Yule.

LIVERPOOL.—Royal Institution, Colquitt Street, 6.30 p.m. I.E.E. Mersey & North Wales Centre. "Germanium and Silicon Power Rectifiers," by T. H. Kinman, G. A. Carrick, R. G. Hibberd and A. J. Blundell.

LONDON.—Savoy Place, 5.30 p.m. Institution of Electrical Engineers, informal meeting. Discussion on "Telephone Development in the United Kingdom," opened by the President.

R.S.A. Lecture Hall, Adelphi, W.C.2, 5 p.m. Royal Society of Arts. Presentation of awards.

MANCHESTER.—Grand Hotel, 6.45 p.m. Institution of Works Managers, Manchester Branch. "Automation," by B. Z. de Ferranti.

NEWCASTLE-UPON-TYNE.—King's College, 6.15 p.m. I.E.E. North-Eastern Radio & Measurements Group. Chairman's address, by A. E. Twycross.

SOUTHAMPTON.—Court Royal Hotel, 8 p.m. A.S.E.E. Southampton Branch. "Mineral Insulated Cables and Accessories," by R. B. Thom.

Tuesday, 16th October

ARBORFIELD.—R.E.M.E. Training Centre, Bailleul Barracks, 7 p.m. I.E.E. London Graduate & Student Section, district meeting. Chairman's address, "The Story of the Submarine Cable," by K. W. E. Gravett.

EDINBURGH.—Carlton Hotel, North Bridge, 7 p.m. I.E.E. South-East Scotland Sub-Centre. Sub-Centre chairman's address, by F. G. Bennett.

GLASGOW.—39, Elmbank Crescent, 7 p.m. I.E.E. South-West Scotland Sub-Centre. Sub-Centre chairman's address, by Dr. J. W. Macfarlane.

GLOUCESTER.—Fleece Hotel, Westgate Street, 6.30 p.m. I.E.S. Gloucester & Cheltenham Centre. "Recent Developments in Plastic Materials," by P. H. Collins.

LEEDS.—1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Utilisation Group. "The Development of a New 3:1 Pole-Changing Motor," by Prof. G. H. Rawcliffe and B. V. Jayawant.

LONDON.—At the Institution of Electrical Engineers, Savoy Place, W.C.2, 6.30 p.m. Association of Supervising Electrical Engineers, London National Lecture. Presidential address, "Engineering Developments in Sound Broadcasting and Television," by Sir Harold Bishop.

MANCHESTER.—Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Supply Group. "Physical Properties and Impulse Strength of Paper," by H. C. Hall and E. Kelk, "The Impulse Strength of Lapped Impregnated Paper Dielectric," by H. C. Hall and D. J. Skipper and "Breakdown Under Impulse Voltages of Solid and Liquid Dielectrics in Combination," by W. G. Standring and R. C. Hughes.

Tuesday, 16th October, to Saturday, 27th October

MANCHESTER. — City Hall, Deansgate. Building Trades Exhibition.

Wednesday, 17th October

CALDER HALL.—Opening of nuclear power station, by H.M. the Queen.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Radio & Telecommunication Section. Chairman's address, "The Electronic Age," by Dr. R. C. G. Williams.

I.E.E. London Graduate & Student Section. Visit to the Times Publishing Co., E.C.4, at 8.30 p.m.

MIDDLESBROUGH.—Cleveland Scientific & Technical Institution, Corporation Road, 6.30 p.m. I.E.S. Tees-Side Group. "The Architect's Approach to Artificial Lighting Design," by G. Grenfell Baines.

NOTTINGHAM. — E.M.E.B. Showroom Theatre, Smithy Row, 7.30 p.m. A.S.E.E. Nottingham Branch. "Rewinding a 10,000 kVA Turbo Rotor," by A. D. Campbell, followed by film.

PRESTON.—N.W.E.B., 19, Friargate, 7.15 p.m. I.E.S. North Lancashire Group. Presidential address, by Dr. W. E. Harper.

RUGBY.—College of Technology & Arts, 6.30 p.m. I.E.E. Rugby Graduate & Student Section. "High Stability Quartz Crystal Oscillators," by D. Donaldson.

SHEFFIELD.—Grand Hotel, 6.30 p.m. I.E.E. Sheffield Sub-Centre. Chairman's address, by G. G. Nicholson.

SOUTHAMPTON.—The University, 7 p.m. I.E.E. Southern Centre. "The Potentialities of Railway Electrification at the Standard Frequency," by E. L. E. Wheatcroft and H. H. C. Barton.

STAFFORD.—Technical College, 7.15 p.m. I.E.E. North Staffs. Sub-Centre Graduate & Student Setcion. Chairman's address, "Automatic Speed Control," by A. P. Baines.

WOLVERHAMPTON. — Wolverhampton & Staffordshire Technical College, 7.30 p.m. Institution of Production Engineers, Wolverhampton Section and Graduates. "Electronic Control in Industry," by E. Heys.

Wednesday, 17th October, to Saturday, 27th October

LONDON. — Earls Court. International Motor Exhibition.

Thursday, 18th October

CHELMSFORD. — Crompton's Social Hall, 7.30 p.m. Chelmsford Engineering Society. "The Development of the Mining Type Belt Conveyor," by H. Streets.

DUBLIN. — Physical Laboratory, Trinity College, 6 p.m. I.E.E. Irish Branch. Chairman's address, by P. H. Greer.

EXETER.—Electricity Showrooms, Bedford Street, 3 p.m. I.E.E. South-Western Sub-Centre. Chairman's address, by W. R. Rowe.

LONDON.—Caxton Hall, S.W.1, 2 p.m. Diesel Engineers' & Users' Association. Annual general meeting, followed by "The Use of I.C. Engine Plant for Peak Loads on Electricity Supply Systems," by J. R. P. Smith.

MANCHESTER.—Café Royal, Peter Street, 12.30 for 1 p.m. Electrical Trades' Commercial Travellers' Association, North Western Branch. Annual luncheon.

N.W.E.B., Town Hall, 6 p.m. I.E.S. Manchester Centre. "School Lighting, Part I," by G. S. Pester and J. Blackie.

MIDDLESBROUGH.—Cleveland Scientific & Technical Institution, Corporation Road, 7.30 p.m. Society of Instrument Technology, Tees-Side Section. "A Nuclear Power Station and its Instrumentation," by K. R. Sandiford.

TONBRIDGE.—Rose & Crown Hotel, 8 p.m. A.S.E.E. Kent Branch. "Electrical Safety," by S. J. Emerson.

Friday, 19th October

BIRMINGHAM. — Grand Hotel, 6.30 for 7 p.m. Birmingham Electric Club. Annual dinner.

Imperial Hotel, Temple Street, 7.30 p.m. Incorporated Plant Engineers, Birmingham Branch, Mobile Plant Discussion Group. "Electrical Safety Concerning Building Sites and Civil Engineering Projects," by G. L. Leighton.

BLACKBURN.—Assembly Hall. Incorporated Plant Engineers, Blackburn Branch. Ladies' evening.

HATHERSAGE.—Millstone Inn. A.S.E.E. Sheffield Branch. Annual dinner and dance.

LONDON.—A.S.E.E. South West London Branch. Theatre visit and supper.

Savoy Place, 6 p.m. I.E.E. Education Discussion Circle. Discussion on "Experiments for the Electronics Laboratory," opened by V. Attree.

1, Birdcage Walk, S.W.1, 6 p.m. Institution of Mechanical Engineers. Presidential address, "Motive Power on Sea and Land," by T. A. Crowe.

NEWCASTLE-UPON-TYNE. — Grey Hall, King's College, 6.30 p.m. I.E.E. North Eastern Graduate & Student Section. "Electricity Distribution in North Eastern England," by J. D. Smith.

PRESTON. — North Western Gas Board, Fishgate, 7.30 p.m. Institution of Production Engineers, Preston Section. "What Automation Means," by F. G. Woollard.

Saturday, 20th October

LONDON.—I.E.E. London Graduate & Student Section. Visit to Bankside generating station, at 10.30 a.m.

OXFORD.—Regents Park College, Pusey Street, 6.30 p.m. A.S.E.E. Oxford, Reading & Districts Branch. "Nuclear Reactors and Instrumentation," by D. D. Bowen.

Courses in Applied Physics

The Institute of Physics and the London and Home Counties Regional Advisory Council for Higher Technological Education are holding a joint conference on "Degree and Diploma Courses in Applied Physics" on 15th and 16th November at the Institution of Electrical Engineers. Among the speakers will be Mr. O. W. Humphreys, Sir John Cockcroft, Mr. R. E. Burnett, Dr. J. Thomson, Professor P. M. S. Blackett, Sir Francis Simon, Professor H. S. Lipson, Professor M. R. Gavin and Dr. J. E. Richardson. On the evening of 15th November an informal dinner will be held at which Sir John Maud, formerly Permanent Secretary of the Ministry of Education, will give an address. A conference fee of one guinea will be charged to all attending. Full details and forms of application may be obtained from Mr. N. Clarke, deputy secretary, Institute of Physics, 47, Belgrave Square, London, S.W.1.

Teaching Electrical Housecraft

The Electrical Association for Women is arranging a one-day conference on "The Teaching of Electrical Housecraft" to be held at Battersea Polytechnic on 24th November. Applications should be made to the E.A.W., 25, Foubert's Place, W.1, not later than 3rd November. The conference fee, including meals, is 10s.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—29th November. Sydney County Council. Twenty-four 600 kVA distribution transformers. (E.S.B. 24866/56. Ten/21787.)*

3rd December. Electricity Commission of New South Wales. Galvanised steel tower transmission line. (E.S.B. 24901/56. Ten/21786.)*

6th December. Electricity Trust of South Australia. Three 67 MVA main step-up transformers. (E.S.B. 24488/56. Ten/21817.)* 20th December. Six 90 MVA step-down transformers. (E.S.B. 24563/56. Ten/21818.)* 60 MVA transformer. (E.S.B. 24561/56. Ten/21857.)* Three 25 MVA synchronous condensers and spares. (E.S.B. 24564/56. Ten/21845.)*

Brecon.—12th November. Borough Council. Street lighting equipment. (See this issue.)

Burma.—24th October. Union Purchase Board. Ironclad oil circuit-breaker. (E.S.B. 24919/56. Ten/21824.)*

Burton-on-Trent.—23rd October. Borough Council. Street lighting equipment. Borough surveyor, Town Hall.

Croydon.—1st November. Corporation. Street lighting equipment. (See this issue.)

Formosa.—30th October. Central Trust of China, Purchasing Department. Galvanised steel wire, copperweld wire, etc. (E.S.B. 24585/56.I.C.A. Ten/21778.)*

India.—22nd October. Government of Mysore. Post and suspension type insulators for 66 kV substations. (E.S.B. 25233/56. Ten/21846.)*

23rd October. Government of Madras. Control and l.v. power cables. (E.S.B. 25234/56. Ten/21853.)*

30th October. Bombay Electricity Board. Diesel-electric power plant and accessories. (E.S.B. 25012/56. Ten/21802.)*

19th October. Director General of Supplies and Disposals. Steel cored aluminium conductor. (E.S.B. 24896/56. Ten/21762.)* 6th November. Paper insulated lead alloy cables. (E.S.B. 24898/56. Ten/21791.)* 24th October. Standard steel-cored aluminium conductors. (E.S.B. 25291/56. Ten/21869.)* 6th November. Paper insulated lead alloy cables. (E.S.B. 24898/56. Ten/21791.)*

Kilmarnock.—19th October. Burgh Council. Street lighting equipment. (See this issue.)

Kirkham.—30th October. U.D.C. Street lighting equipment. Surveyor, Council Offices, Moor Street, Kirkham, Preston, Lancs.

Longbenton.—5th November. U.D.C. Street lighting equipment. (See this issue.)

Lydney.—2nd November. Parish Council. Street lighting equipment. (See this issue.)

New Windsor.—10th November. Borough Council. Electric lamps (Schedule 15) and electric fittings and cable (Schedule 21) for the year ending 31st December, 1957. Borough engineer, Kipling Buildings, Alma Road, Windsor.

Northern Ireland.—12th November. County of Armagh. Education Committee. Electrical installation in the proposed county intermediate schools and central school meals kitchen, Lurgan. J. McCandless, consulting engineer, 6, Murray Street, Belfast.

Pakistan.—24th October. Government Department of Supply and Development. Switchboards. (E.S.B. 24745/56. Ten/21753.)* Switches, cables and plugs. (E.S.B. 24744/56. Ten/21752.)*

Portuguese West Africa.—7th November. Luanda Light and Water Services. Transformers, switchgear and cable. (E.S.B. 24312/56. Ten/21808.)*

Redruth.—22nd October. C.C. Electrical installation in the new county secondary school. (See this issue.)

South Africa. — 24th October. Stores Department, South African Railways. Fault locators. (E.S.B. 24985/56. Ten/21812.)* 31st October. 8,900 40-400 W lamps. (E.S.B. 24986/56. Ten/21785.)* Insulated electric cable. (E.S.B. 24777/56. Ten/21768.)* 2nd November. Transformers and switchboards. E.S.B. 24779/56. Ten/21767.)* Telegraphic line materials. (E.S.B. 24780/56. Ten/21773.)* Lightning arrestors. (E.S.B. 24778/56. Ten/21766.)* Copper and steel wire. (E.S.B. 24892/56. Ten/21796.)* Underground armoured paper insulated cable. (E.S.B. 24891/56. Ten/21769.)* 21st December. Traction substation convertor equipment. (E.S.B. 24592/56. Ten/21750.)*

1st November. Union Tender and Supplies Board. Telephone plugs. (E.S.B. 25140/56. Ten/21838.)*

Syria.—13th November. Director General of Posts, Telegraphs and Telephones, Damascus. Silk insulated electric wire. (E.S.B. 24996/56. Ten/21801.)*

ORDERS PLACED

Bradford.—Public Works Committee. Electrical work at five blocks of three-storey flats and four-storey maisonnettes (45 dwellings) on the Wood Side estate (£2,592).—J. Carter.

East Anglia.—Regional Hospital Board. Recommended. Installation of electrical services in connection with reorganisation of the main kitchen at the Little Plumstead Hospital, Norwich (£3,205).—E. H. Ruddock. Electrical services in connection with alterations and additions to ward blocks at the Northgate Hospital, Great Yarmouth (£3,397).—Boardley & Roberts.

Newcastle-on-Tyne. — Education Committee. Electrical installation at Montagu No. 2 County Primary School (£3,010).—T. Mitchelson (Electrical).

St. Helier (Jersey).—Town Council. Accepted. Sixteen sets of electromatic vehicle-actuated traffic signals.—Automatic Telephone & Electric Co., Ltd.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Aldershot.—Flats (92), North Town area; borough surveyor.

Altrincham.—Houses and flats (66), on Broomwood estate; A. Glossop, town clerk, Town Hall.

Barnsley.—Houses (100), Yew's Farm estate, and (100) on Rotherham Road site; C. R. Hollingsworth, borough surveyor, Town Hall.

Bristol.—Primary school, Withywood; John Knox, Ltd., builders, Winterstoke Road.

Bullingdon.—Houses (200), shops, etc., as development of Field Farm estate, Dorchester-on-Thames; J. E. Busfield, R.D.C. surveyor, 76, Banbury Road, Oxford.

Darlington.—Bus station and garage for United Automobile Services, Ltd.; A. A. Briggs, architect, 10, Fleet Street, London, E.C.4.

Branch stores, Firth Moor estate, for Darlington Co-operative Society; C.W.S. Architects' Dept., 90, Westmorland Road, Newcastle-on-Tyne.

Exeter.—Houses (102), on sites at Countess Wear, Heavitree Bridge and Stoke Hill; H. B. Rowe, city architect, Municipal Offices.

Folkestone.—Two-storey offices, showrooms, repair shops, etc., Cheriton Road; F. H. Peacock, Ltd., automobile engineers, 104, Foord Road.

Gloucester.—Factory, Bristol Road; Permali, Ltd., 46, Victoria Street, London, S.W.1.

Grays (Essex). — Departmental stores, Orsett Road, for Co-operative Wholesale Society, Ltd.; W. J. Reed, Architects' Department, 99, Leman Street, London, E.C.1.

Harrogate. — Home in Otley Road (£40,000); Yorkshire Association for the Care of Cripples, 9, Mount Preston, Leeds, 2.

Hereford.—Additional factory buildings for Henry Wiggin & Co., Ltd., Holmer Road; Robert M. Douglas, Ltd., contractors, 395, George Road, Erdington, Birmingham.

Isle-of-Man.—Twin operating theatres and nurses' training school, Nobles Hospital; W. T. Quayle, architect, 29, Athol Street, Douglas.

Hall and offices, Derby Road, Peel; A. J. Davidson, architect, 16, Athol Street, Douglas.

Keighley.—Infants' school, Guardhouse estate; E. G. Felgate, architect, Cook Street.

Leeds.—Dwellings (130), Beckett Park; city architect.

Maidstone.—Shops (18), offices and housing units (34), at main shopping centre, Northumberland Road, Shepway Farm estate; borough surveyor, Palace Avenue.

Middlesbrough.—New stores for British Home Stores, Ltd., London; Fairweather and Co., Ltd., builders, St. James's Lane, Muswell Hill, London, N.10.

Newcastle-on-Tyne.—General store, oil store, electrical substation and medical centre for Vickers Armstrongs, Ltd.; Ley Colbeck and Partners, architects, Bishopsgate, London, E.C.2.

Oxford.—Market at 138-140, London Road; Oxford & District Co-operative Society, Ltd., 65, George Street.

Oxted.—Church; Minoprio, Spencely & McFarlane, architects, 18, Seymour Street, London, W.1.

Romford.—Warehouse; Jamaica Producers Marketing Co., Ltd., 10, Bedford Street, London, W.C.2.

Rotherham.—Central bus station on site adjoining Frederick Street; E. J. Manson, borough surveyor, Municipal Offices.

Stockton-on-Tees.—Office block, Bridge Road, for J. L. Robson and Son; R. Brown, architect, 123, Victoria Road, Darlington.

Works additions for the Power Gas Corporation, Ltd. (£1,000,000).

Swindon.—Houses (80), Walcot neighbourhood unit; Bare, Leaning & Bare, architects, 3, Argyle Street, Bath.

Scientific research building, Kembrey Street; Plessey Co., Ltd., Vicarage Lane, Ilford.

Taunton.—First phase of college of art in Wellington Road; R. O. Harris, Somerset county architect, Park Street.

Uttoxeter.—Houses (34), Weaver Lodge estate; John H. Kenny, U.D.C. clerk, Old Bank House, 72, High Street.

Wakefield.—Secondary school, Thornes Road; Rex Proctor & Partners, 15, Blenheim Terrace, Leeds.

Dwellings (256), Kettlethorpe estate; N. B. Bell & Co., Ltd., Frankland Terrace, Leeds.

---

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).